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Young people's physical activity, attitudes towards physical education, and health related fitness

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YOUNG PEOPLE'S PHYSICAL ACTIVITY, ATTITUDES TOWARDS PHYSICAL EDUCATION, AND HEALTH RELATED FITNESS

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Abstract

The aim of this study was to assess the physical activity, attitudes towards physical education, and health related fitness at two points, one year apart (Phase One and Phase Two). Three hundred and ninety four secondary school pupils of mixed ethnicities from National Curriculum school years 7, 8 and 9 (mean age ± S.D. = 12.9 ± 0.81 years) participated in phase one of the study. Two hundred and sixty seven pupils (from the original 394 participants) from National Curriculum school years 8, 9 and 10 (mean age ± S.D. = 13.7 ± 0.79 years) took part in phase two one year later. Physical activity was measured using the four by one-day physical activity recall questionnaire (Cale, 1993). Attitude was measured using the Pre-Adolescent Attitude towards Physical Education Questionnaire (PAAPEQ) (Shropshire, 1997). Five components of health related fitness were measured in a randomly selected sub-sample (35%) of the overall sample: body composition (measured using skinfold measures and body mass index); cardiovascular endurance (measured using the twenty metre multistage fitness test, Brewer et al., 1988); flexibility (measured using the sit and reach test); muscular strength (measured using hand grip dynamometry); and muscular endurance (measured using sit-ups).

Results of repeated measures ANOVA revealed a significant decrease in energy expenditure between phase one and phase two ($p<0.01$) and young people's energy expenditure was higher during weekends (especially Saturdays) than during school days ($p<0.01$). Young Asians were found to

expend less energy than white and black pupils ($p<0.01$) and boys expended more energy than girls ($p<0.01$). No main effect according to school year was found ($p>0.05$) although a significant 'time' by 'days' of the week interaction was revealed; pupils in Year 8 were more active on school days than those in Years 7 and 9 ($p<0.05$). Non-parametric analyses conducted on time spent in moderate physical activity (MPA) and vigorous physical activity (VPA) indicated that: MPA and VPA decreased between phases one and two; Asians consistently spent less time in MPA than white and black pupils ($p<0.01$); boys engaged in more MPA and VPA than girls ($p<0.01$). However, the difference in mean reported time for boys and girls decreased between phases one and two. Percentages of the whole sample meeting optimal activity guidelines and percentages classified as active or moderately active decreased between measurements for the whole sample.

With regard to attitudes towards PE, results from MANOVA revealed a significant 'school year' x 'ethnicity' x 'gender' interaction ($p<0.05$). Attitudes of black males became more positive with age whereas the attitudes of other groups followed an age related decline. Significant main effects were found according to school year ($p<0.01$) and ethnicity ($p<0.05$). Attitude towards PE became less favourable with school year. Asian pupils had more positive overall attitudes than white and black pupils but univariate analysis revealed that Asian pupils had a less positive attitude towards their PE teacher ($p<0.05$). Furthermore, Pearson's product moment correlations indicated weak yet significant positive relationships between total attitude towards PE and energy expenditure ($p<0.01$), time spent in moderate activity ($p<0.05$) and time spent in vigorous activity ($p<0.01$).

Results of repeated measures ANOVA conducted on health related fitness data revealed that, for all groups, body fat ($p<0.05$) and muscular endurance ($p<0.01$) increased between phases one and two. In both phases, significant positive relationships were found between muscular endurance and energy expenditure ($p<0.01$) and vigorous activity ($p<0.05$ and $p<0.01$ for phases one and two respectively). Therefore, young people who were more active had greater levels of muscular endurance. No further consistent findings were made.

Findings indicate that generally young people's physical activity decreases with age and that girls are less active than boys although as young people age the physical activity gap between the genderes narrows. Findings also lend support to the idea that cultural differences may influence physical activity levels and attitudes towards PE. Furthermore, associations between physical activity and attitude towards PE exist and therefore, attitude may be used to predict physical activity behaviour. Ethnicity, age, and attitude towards PE should be considered in the development of future interventions to increase young people's physical activity levels. However, as the current study did not reveal strong associations between physical activity and health related fitness, further research is required in the area.

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Preface

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Woodfield, L., Duncan, M., Al-Nakeeb, Y, Nevill, A. (2002) The physical activity of children from different ethnic groups. Proceedings of BASES Annual Conference, University of Wales Newport, 4-7 September 2001. *Journal of Sports Sciences*. 20 (1): 43-44

Woodfield, L., Duncan, M., Al-Nakeeb, Y. and Nevill, A. (2003) The relationship between young people's physical activity levels and attitude towards physical education. Proceedings of the European College of Sports Science Conference, 9-13 July 2003, Salzburg, p432.

Woodfield, L., Al-Nakeeb, Y. and Nevill, A. (2005) Longitudinal changes in the physical activity levels of young people from different ethnic groups. Proceedings of the BASES Annual Conference, 5-7 September 2005, Loughborough University. *Journal of Sports Sciences*. 23 (11): 1166-1167

Woodfield, L., Al-Nakeeb,Y. and Nevill, A. (2006) Young people's attitudes towards physical education. BASES Annual Conference, 11-13 September 2006, University of Wolverhampton.

1.0 INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

The various health benefits associated with a physically active lifestyle have been well documented. The development of hypokinetic diseases such as coronary heart disease (CHD), hypertension, obesity and osteoporosis in adulthood are associated with low adult physical activity levels (Sallis and Patrick, 1994). Furthermore, although physical inactivity carries equal risk to other lifestyle-related CHD risk factors such as smoking, the prevalence of inactivity within society can be up to three times higher (White et al., 1993[1]). The prevalence of sedentary living and the impact of inactivity on increased disease risk suggests that public health efforts should be directed towards getting more people more active more often (American College of Sports Medicine, 2000) and that any increase in physical activity from a state of sedentriness is beneficial to health (Riddoch and Boreham, 2000).

Although a physically active lifestyle has the potential to confer health benefits on children and adolescents as well as adults (Sallis and Patrick, 1994) the evidence base for the benefits of physical activity in young people is inconclusive (Patrick, Norman, Calfas, Sallis, Zabinski, Rupp and Cella, 2004; Twisk, 2001) with strong evidence only relating to adult physical activity and adult health status (Boreham and Riddoch, 2001). Blair et al. (1989) hypothesised relationships between physical activity levels and health during both childhood and adulthood (Figure 1). It has been recognised that evidence is mounting to support that there are indeed relationships between childhood physical activity, physical fitness and current and future health

[1] White, A., Nicholaas, G., Foster, K., Browne, F. and Carey, S. (1993) *Health Survey for England: OPCS health survey no.1*. HMSO, London. Cited in Riddoch and Boreham (2000)

(Boreham and Riddoch, 2001) and that associations are in the "healthy direction" (Harris and Cale, 2006: 202). Therefore, being more active during childhood is associated with health benefits during childhood and adulthood. However, there has been some criticism of the scientific rationale behind proposed physical activity guidelines for young people (Twisk, 2001).

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Figure 1. Hypothetical relationship between physical activity and health in children and adults. Taken from Blair et al. (1989)

Research conducted in the United States found that childhood overweight status tracked into young adulthood with overweight children more likely to become overweight adults (Deshmukh-Taskar, Nicklas, Morales, Yang, Zakeri and Berenson, 2006). Although it has been stated that patterns of health related behaviours are often acquired and established during childhood and adolescence (Harris, 1998), the current evidence base to support the tracking of physical activity throughout the life course is limited as relatively few longitudinal studies have been conducted in the area due to the methodological demands of such study designs (Ben-Shlomo and Kuh, 2006). However, a British cross-sectional study identified that those adults who were more physically active as children were more active in adulthood (Allied

Dunbar National Fitness Survey, 1992) and there is suggestive evidence that physical activity tracks over a relatively short period of time (3-5 years) (Pate, Trost, Dowda, Ott, Ward, Saunders and Felton, 1999); that is from childhood to adolescence and from adolescence to adulthood. Research conducted by Janz, Dawson and Mahoney (2002) proposed that sedentary activity and vigorous activity are moderately stable variables that track from late childhood into middle adolescence even though this is a period of substantial psychological and biological development. Therefore, there is the need for further research into the tracking of physical activity and health-related fitness particularly amongst children and young people.

Young people are at the same risk of a sedentary lifestyle as adults either during their childhood or when they themselves become adults. Children and adolescents are exposed to physically inactive pursuits such as watching television and playing video and computer games which occupy a large part of their leisure time (Pate, Long and Heath, 1994). Although children's general fitness does not appear to have changed over the last century (McNab, 1992) more recent work has suggested that young people who watch more than four hours of television per day are 40% more likely to be classified as overweight (Eisenmann, Bartee and Wang, 2002). Consequently, many children are failing to attain the activity level recommendations, which are thought to be necessary to confer health benefits in later life due to sedentary activity.

A decline in physical activity is present in all groups within the child population, however, a range of studies have found that physical inactivity is more marked in certain population groups than in others (Novak, Ahlgren and Hammarström, 2006; Trost et al., 2002; Raudsepp and Viira, 2000; Verma et al., 1991[2]; Carrington et al., 1987). It has been recommended that specific groups of young people (5-18 years old) should be targeted for physical activity intervention strategies and in 1998, the Health Education Authority (HEA), now renamed the Health Development Agency (HDA), identified priority groups within the United Kingdom which included adolescent girls, young people of low socio-economic status, older adolescents (16-18 years), black and minority ethnic groups, physically and mentally disabled and those with clinical conditions such as obesity (HEA, 1998). In addition, it has previously been suggested that physical activity in terms of organised sport should become “equally accessible to everyone in society, whatever their ethnic origin, age, gender or level of ability” (Sports Council, 1994: 4).

Unfortunately, children’s attitudes towards physical activity are not always positive. As previously mentioned, an active childhood can result in an active adulthood yet many children are inactive and previous research suggests that physical education (PE) has the potential to encourage physical activity outside school (Sallis and McKenzie, 1991)[3] and that participation in physical activities outside of school can be attributed to students’ attitudes towards PE (Carlson, 1995). It has been found that some children, irrespective of population group, have a dislike for the subject of physical education (PE) based on lesson content or contextual factors such as PE kit and outdoor

[2] Verma, G., MacDonald, A., Darby, D. and Carroll, R. (1991) *Sport and Recreation with Special Reference to Ethnic Minorties*, Unpublished research report, Centre for Ethnic Studies in Education, University of Manchester. Cited in Figueroa (1993)

[3] Sallis, J. and McKenzie, T. (1991) Physical Education’s role in public health. *Research Quarterly for Exercise and Sport,* 127: 933-941. Cited in Shropshire, Carroll and Yim (1997)

winter sports (Williams and Bedward, 1999). Therefore, it can be argued that PE can have a demotivating effect, as opposed to a promoting effect, on physical activity due to the negative attitude that some young people develop.

Some young females and members of the ethnic minorities suffer from additional pressures which can be used to explain negative attitudes towards both PE and physical activity. Hopwood and Carrington (1994) reported that girls consider sport and competitiveness a masculine trait whilst Armstrong and McManus (1994) suggested that girls do not enjoy physical activities due to a feeling of alienation with regard to their physiques. With reference to members of black and Asian communities in England, Rai and Finch (1997) reported that as well as the potential threat from racism, adults and children alike are tied by family and community commitments which are of greater importance than personal choice. Therefore, young females and those from black and minority ethnic groups are less likely to engage in physical activity and school sport than other groups.

It has been suggested that insufficient levels of physical activity in childhood are a likely result of a variety of issues including attractive sedentary leisure time activities and "out-dated" modified and traditional sports which are available in community settings (Naughton, Carlson and Greene, 2006) which fail to acknowledge the diverse activity interests of young people. The education system provides an arena where physical activity and healthy lifestyles can be promoted as sport and physical activity are presented to almost all pupils (Cale and Harris, 2006; Carr, Weigand and Hussey, 1999).

However, currently the school environment is failing to instil the significance of a physically active lifestyle for future health and well-being (Naughton et al., 2006) as the prevalence of overweight and obesity among young Britons continues to rise (Wardle, Henning Brodersen, Cole, Jarvis and Boniface, 2006). This rise is in spite of statutory frameworks (e.g. knowledge and understanding of fitness and health in the National Curriculum for PE, for England) and various strategies (e.g. PE and school sport club links strategy, PESSCL) aimed at providing young people with opportunities to become "independently active for life" (Harris and Penney, 2000: 252). Although it has previously been suggested that young people are more active throughout the school day than during their domestic leisure time due to the sedentary activities they have available to them (Sharp, 1995), research findings are inconsistent and studies have found that physical activity undertaken outside of school hours is a key contributor to a child's overall level of physical activity (Cox, Schofield, Greasley and Kolt, 2006).

1.2 Physical activity, exercise and physical fitness

Confusion occurs over the meaning of the term physical activity and alternative words are used in its place such as exercise and physical fitness. However, these words cannot be used interchangeably, as they are distinct concepts. Caspersen, Powell and Christenson (1985) provided a series of definitions that are widely accepted in present day physical activity research and are important in developing an understanding of the various concepts. Physical activity is defined as any bodily movement that results in energy expenditure which would therefore include everyday tasks such as transportation, work or recreation. Exercise, on the other hand, is a facet of physical activity which is planned, structured and repetitive and carried out to improve or maintain physical fitness. Finally, physical fitness is a set of attributes that people have enabling them to perform physical activity. The components of health-related fitness which contribute to both sporting performance and daily or occupational tasks are commonly accepted to be cardio-respiratory endurance, muscular strength, muscular endurance, flexibility and body composition.

1.3 Benefits of regular physical activity

Among adults, physical activity affects many systems of the body and provides numerous health benefits (Bouchard et al., 1994). There is substantial evidence that regular aerobic activity such as walking, jogging, dancing or swimming is beneficial to general physical and psychological health. Regular and sustained physical activity confers protection from chronic diseases such as cardiovascular diseases and non-insulin dependent diabetes as well as reducing the risk of osteoporosis and certain cancers (Sallis and Patrick, 1994). Moreover, the list of chronic diseases and conditions favourably affected by exercise and a physically active lifestyle continues to grow (Department for Health, 2004; ACSM, 2000). This list encompasses a diverse range of conditions including the reduction in coronary disease risk factors (such as hypertension, blood cholesterol, total body fatness), an enhanced feeling of well-being and a decrease in anxiety and depression (Pollock, Gaesser, Butcher, Despres, Dishman, Franklin and Ewing-Garber, 1998). The ACSM (2000) also state that there is a clear inverse relationship between physical activity and mortality risk with a further indication that some exercise is better than none, and more exercise, up to a point, is better than less. Thus, evidence suggests that for those who participate regularly, physical activity provides a number of benefits to health.

It is important to note that fitness levels are not solely dependent upon activity levels. It has been previously reported that physical fitness is primarily genetically determined but can be improved by regular and appropriate activity (Riddoch and Boreham, 2000). Although research has suggested that genetic factors influence the susceptibility to obesity, it is accepted that the marked changes in the prevalence of obesity over recent decades must be as a result of major changes in behavioural factors such as diet and physical activity (Rosenbaum and Leibel, 1998).

1.3.1 Benefits and risks of physical activity in young people

Whilst the benefits of physical activity during the adolescent years have been studied with less frequency than among adults, the research base continues to grow. Sallis and Patrick (1994) state that there are significant health concerns in adolescence that are influenced by physical activity such as adiposity, psychological functioning, immune status, and the risk of musculoskeletal injury. More recent work has supported this assertion by suggesting that coronary heart disease risk processes originate in childhood (Thomas, Baker and Davies, 2003). It has been suggested that physical activity can have multiple and varied beneficial health outcomes in young people for both current and future health (Biddle and Mutrie, 2007) and a review of previously published research in the area has concluded that young people, as well as adults, who participate in physical activity will accrue health benefits (Strong, Malina, Blimkie, Daniels, Dishman, Gutin, Hergenroeder, Must, Nixon, Pivarnik, Rowland, Trost and Trudeau, 2005). Strong and colleagues reviewed some 850 articles and made physical activity recommendations for youth based upon the findings of others. From reviewing previously published work, the following were identified as some of the benefits of a physically active lifestyle: improved coronary heart disease risk profile; lower levels of adiposity, overweight and obesity; improved mental health; improved academic performance; and a reduced risk of osteoporosis.

Although there is growing conviction that adult health and well-being and "the origin of many chronic diseases lies in childhood" (Twisk, 2001: 618) the symptoms of coronary heart disease (CHD) do not appear until later on in life, yet, CHD is often recognised as being a paediatric problem. Coronary heart disease risk factors such as obesity, hypertension, smoking and lack of physical activity, amongst others, have already been identified in childhood (Raitakari, Taimela, Porkka, Telama, Valimaki, Akerblom and Vikari, 1997), and more recently, research conducted by Field, Cook and Gillman (2005: 163) found that, among males, "an elevated BMI in childhood predicated the risk of hypertension in young adulthood", thus, there is a real need for beginning the prevention of these adult diseases during the first two decades of life (Sallis and Patrick, 1994). One way in which this could be achieved is by increasing activity levels in childhood and for activity to track into adulthood. However, findings of the Amsterdam Growth Study conducted over a period of 15 years found that activity level after the adolescent period is "of utmost importance" to physical fitness (Kemper and van Mechelen, 1995: 186) and that physical activity has a role to play in reducing body fatness (Twisk, Kemper and Snel, 1995). It is important to consider that with particular reference to overweight and obesity, energy imbalance is the main issue (Bar-Or and Rowland, 2004; Fox, 2003) and, therefore, in addition to physical activity, the diet and calorific intake of young people needs to be addressed.

Due to its impact upon both physical and psychological health (Dehghan, Akhtar-Danesh and Merchant, 2005), research into overweight and obesity is of growing interest. Obesity is recognised as a serious health problem which reduces life expectancy by increasing a person's risk of developing coronary heart disease, hypertension, type II diabetes (Bouchard, 2000). Several studies have identified an association between physical activity and body composition. Tudor-Locke, Ainsworth, Whitt, Thompson, Addy and Jones (2001) found pedometer-determined activity to be inversely correlated with BMI and percent body fat in adults. Among Canadian children, Tremblay and Willms (2003) found that sedentary behaviour is associated with an increased prevalence of obesity. Most school-based intervention studies conducted among youth (6-19 years), adopting either diet and/or physical activity programmes, are effective at reducing BMI and/or percent body fat (Doak Visscher, Renders and Seidell, 2005). In their review of 25 interventions, Doak and partners found 17 to be effective and concluded that modified physical education provision in school and reduced television watching are two examples of effective physical activity intervention strategies. In addition, Flodmark, Marcus and Britton (2006) reported that the prevention of obesity among children and adolescents is possible through school-based programmes that combine physical activity and healthy diet promotion.

Overweight and obesity is a serious public health problem due to its increasing prevalence among youth worldwide (Doak et al, 2005). Research conducted in the U.K. found that between 1984 and 1994, the prevalence of overweight or obesity among Primary school aged English boys increased by 1.7% (Chinn and Rona, 2001). Chinn and Rona's cross-sectional studies also found more marked percentage increases among English girls (2.6%), and Scottish boys (2.1%) and girls (3.2%). Lobstein, James and Cole (2003) observed a similar trend among seven to eleven year olds in England with obesity increasing from 8% to 20% over a fourteen year period. Further work conducted in Northern England among infants also found a significant increasing trend in both overweight (from 14.7% to 23.6%) and obesity (from 5.4% to 9.2%) over a ten year period (Bundred, Kitchiner and Buchan, 2001). In their review of childhood obesity, prevalence and prevention, Dehghan et al. (2005) acknowledge that although the highest prevalence of childhood obesity is in developed countries this prevalence is increasing in developing countries as well. Furthermore, it has been found that a higher BMI in childhood predicted becoming overweight or obese in young adulthood (Field, Cook and Gillman, 2005). Therefore, overweight and obesity is a global concern among young people and that weight status is strongly associated with physical activity.

Although the review conducted by Strong et al. (2005) established the various health benefits of physical activity, it is important to note that other work has suggested that the relationship between physical activity and health in youth is complex (Twisk, 2001). For example, the work of Guerra, Teixeira-Pinto, Ribeiro, Ascensao, Magalhaes, Andersen, Duarte and Mota (2006) found that between the ages of 8-15 years, boys classified as less active were more likely to be obese than those classified as more active whilst no such association was found amongst girls of the same age. However, previous research made findings to the contrary, namely that obesity in girls is linked to low levels of physical activity but no relationship was found amongst boys (Mota, Santos, Guerra, Ribeiro and Duarte, 2002).

In addition to Strong et al.'s (2005) review of a range of literature conducted in the area of physical activity and mental health (including anxiety, depression and self-concept), associations have been found among adolescent physical activity and body satisfaction. Neumark-Sztainer, Goeden, Story and Wall (2004) found that young people (aged 11-18 years) with lower body satisfaction reported less physical activity. Therefore, interventions which aim to prevent eating disorders through focussing on body image may consider the positive impact physical activity can have on body satisfaction.

Research suggests that adult health status is largely determined by biological events which occur during foetal growth (Barker, 1990), such as low birth weight and CHD risk factors in adults (Barker, 1993). Boreham and Riddoch (2001: 920) discussed how these early biological events trigger a "morphological or functional change" that will manifest as a chronic disease in adult life, however, it was acknowledged that only limited evidence exists to support the hypothesis. More recently, there has been a growing interest in a life course approach to chronic disease epidemiology. This approach considers the "long-term effects on chronic disease risk of physical and social exposures during gestation, childhood, adolescence, young adulthood and later adult life" (Ben-Shlomo and Kuh, 2002: 285). Indeed, the physical exposure can be a result of a social or environmental influence. Whereas cohort studies relate the risk of developing disease to baseline exposures, or changes in exposure, a life course approach attempts to explain disease causation by considering the timing of the exposure variable or variables. For example, Novak, Ahlgren and Hammerström (2006: 198) found that "multiple adverse circumstances" experienced by Swedish adolescents (16 years old) and young adults (30 years old) resulted in social economic status (SES) inequity in overweight. Novak and colleagues concluded that specifically among low SES groups, physical inactivity and alcohol consumption during young adulthood were important factors in overweight men but in women overweight was explained mainly by adolescent factors including physical inactivity, parental divorce and not being popular at school. Although, the life course approach has helped to "bridge biological, psychological and social models of disease causation" it must be acknowledged that such studies are complex to conduct (Ben-Shlomo and Kuh, 2006: 291).

1.4 Physical activity recommendations for health

1.4.1 Recommendations for adults

There is a general consensus on the optimal level of physical activity for adults based upon evidence highlighting the strong link between physical activity levels and physical fitness and health and well-being (Riddoch, 1998). It is widely accepted that the recommendations for adult physical activity to maintain optimum health is: the frequency of training should be between three and five days per week, at an intensity level of 55-90% of maximum heart rate and for a duration of 15-60 minutes of continuous aerobic activity (ACSM, 2000). The modes of exercise categorised as being cardiovascular/aerobic activities that are traditionally prescribed most frequently are: walking, jogging, running, hiking, cycling, rowing and swimming (Wilmore and Costill, 2004). In addition to these activities, alternatives have been identified (such as racquet sports and aerobic dance) that promote similar cardiovascular endurance gains (Wilmore and Costill, 2004).

However, it has been suggested that more traditional exercise recommendations fail to acknowledge the health benefits associated with regular participation in intermittent physical activity that is of moderate intensity (Pollock et al. 1998). It has been previously suggested that similar benefits of physical activity are gained whether the daily endurance training session is conducted in single long bouts (e.g., a single 30-min bout) or multiple shorter ones (e.g., three 10-min bouts) (Wilmore and Costill, 2004). For example, the research of De Busk et al. (1990) found that the accumulation of shorter periods of physical activity was sufficient to maintain heart health.

1.4.2 Recommendations for young people

As discussed previously, there is increasing interest in the notion that young people should be encouraged to adopt an active lifestyle to confer health benefits in later life. However, the relationship between activity and health in children is less clear (Riddoch, 1998) and there is much scepticism surrounding the evidence base for the physical activity and health relationship primarily due to fact that symptoms of a physically inactive lifestyle are not apparent until adulthood (Twisk, 2001). Subsequently, the highly prescriptive recommendations for adults are absent in the case of young people and there is uncertainty about the precise activity requirements for children. Even by the early 1990s no consensus had been reached for youth physical activity standards (Sallis, 1993) and during this time research from both North America and the United Kingdom erred on the side of caution when promoting activity recommendations for children and young people.

According to the ACSM (2000) special precautions are required when applying exercise programmes to children because they are anatomically, physiologically and psychologically immature. Quite simply, children are not adults in small bodies. Furthermore, the difference between adult and childhood activity patterns has been recognised (Welk, Corbin and Dale, 2000). It is in now widely accepted that although children, do engage in high intensity activity, they do not raise their heart rates for sustained periods of time and physical activity tends to be intermittent in nature (Armstrong and Welsman, 1997), therefore, adult standards for activity would show children to be inactive (Pangrazi et al., 1997). In addition, previous work has suggested that children do not need to receive the same levels of physical activity prescription as adults, maintaining that any increase in activity will probably lead to similar health benefits as that achieved by published recommendations (Twisk, 2001; Rowland, 1990). Indeed there has been criticism of the scientific rationale behind proposed physical activity guidelines for young people (Twisk, 2001). Twisk critically reviewed the evidence that exists to support the development of such activity guidelines. The review suggested that the evidence base was insufficient to support the notion that: (1) physical activity during youth is related to health status in youth; (2) physical activity during youth is related to health status in adulthood; (3) physical activity during youth is related to physical activity during adulthood. In conclusion, it was proposed that experimental research is required to establish the effects of different frequencies, durations, modes and volumes of physical activity on health outcomes in order to provide guidelines for youth activity.

Previously, a joint recommendation for physical activity among North Americans from Centers for Disease Control, the ACSM and the President's Council on Physical Fitness and Sports, recognised the value of any activity that expends calories irrespective of continuous moderate to vigorous physical activity (MVPA) and acknowledges that some activity is better than none at all (Pate et al., 1995)[4]. Sleap and Warburton (1994) were in agreement with this idea, deeming it inappropriate to expect young children to engage in lengthy, continuous periods of MVPA. They continued to suggest that it would seem more natural for children to participate in shorter bursts of activity which are repeated frequently (Sleap and Warburton, 1994). Considering the research base questioning the appropriateness of adult physical activity guidelines, the HEA (1998) stipulated that childhood activity can be either performed continuously (for sustained periods) or intermittently accumulated throughout the day (several bouts of shorted duration e.g. 5-10 min.) as this is a more practical approach. Following a review of previously published work, it has been concluded that children have "a better ability than adults at repeating short-term sprints when recovery intervals are short" (Ratel, Lazaar, Dore, Baquet, Williams, Berthoin, van Praagh, Bedu and Douche, 2004: 279). Therefore, when compared with adults, children have a better physiological capacity for intermittent, high intensity activity. Whether the health benefits gained from frequent short bursts of activity are comparable with the gains from sustained periods of moderate to vigorous activity has been questioned (Shropshire and Carroll, 1998) although it has been suggested that high-intensity intermittent training programmes can significantly improve the aerobic fitness of children (Ratel et al., 2004).

The International Consensus Conference on Physical Activity Guidelines for Adolescents convened in 1993 to produce one of the earliest sets of

[4] Pate, R.R. et al. (1995) Physical activity and public health. Journal of the American Medical Association, 273(5): 402-407. Cited in Pangrazi, Corbin and Welk (1997)

comprehensive physical activity recommendations for young people. The conference also established age-appropriate physical activity guidelines for adolescents (i.e. 11-21 years of age) and considered how these guidelines could be implemented into primary health care settings (Sallis and Patrick, 1994). Guideline one recommended that all adolescents should be physically active daily, or nearly every day, as part of play, games, sport, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities. Guideline two suggested that adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that require moderate to vigorous levels of exertion (Sallis and Patrick, 1994).

Physical activity guidelines, again formulated as a result of a symposium of experts including representatives from the Sports Council and the then Physical Education Authority of the United Kingdom (now the Association for Physical Education), were released in 1998 in the HEA's policy framework titled Young and Active? Laventure (1998), in agreement with HEA (1997), stated that as the recommendations for young people in North America had been given limited exposure within the field of physical education and health in the UK, detailed recommendations for young people can have a de-motivating effect and make physical activity unappealing for young people. Thus, the guidelines laid out by the HEA (1998) were divided into primary and secondary recommendations for encouraging young people (5-18 years old) to take part in regular physical activity. The rationale was comprised of three aims: to optimise current fitness, health and well-being and growth and development; to develop active lifestyles that can be maintained throughout adult life; and to reduce the risk of chronic diseases in adulthood (HEA, 1998:3). Primary recommendations suggested that all young people should participate in physical activity of at least moderate intensity for one hour per day and that those who currently do little activity should participate for at least half an hour per day. Secondary recommendations identified that at least twice a week some of these activities should help to enhance muscular strength and flexibility and bone health. Muscular strength and flexibility exercises have numerous health benefits including reducing the risk of injury and protection against future conditions such as low back pain and osteoporosis (Department of Health, 2004; Vuori, 2001).

In conclusion, the HEA'S recommendations advocate that young people should be active every day and that twice a week activity should be structured in such a way as to accrue specific health outcomes. The symposium decided that one hour of physical activity was preferred and justified this by the notion that although the majority of young people in the United Kingdom currently meet a 30 minute criterion of moderate intensity per day, childhood obesity is on the increase (HEA, 1998). To add credence to the HEA's recommendations, a more recent panel of experts was convened in North America and concluded that school-age youth should participate daily in 60 minutes or more of moderate to vigorous activity which is "developmentally appropriate, enjoyable, and involves a variety of activities" (Strong et al., 2005: 732).

1.5 Young people's physical activity levels

It has been stated that the physical activity of children and adolescents "vary with age, type of exercise and setting" (Strong et al., 2005:736). It is widely accepted that pre-teenagers are the most physically active segment of the population (Sallis, McKenzie, Elder, Hoy, Galati, Berry, Zive and Nader, 1998), that is, as a general rule, children are more active than adults (ACSM, 1995), and children are the fittest population group (Armstrong and McManus, 1994). Although children are not continuously active, they accumulate more minutes of intermittent activity every day than adults and teenagers (Pangrazi et al., 1997), yet it should be noted that between the ages of 6-9 years, activities are largely anaerobic (Strong et al., 2005). The difference between child and adult activity levels can be linked with fewer time restrictions placed upon them (Pangrazi et al., 1997), however, to date research findings in the area of young people's physical activity have been inconclusive.

Sleap and Warburton (1996) used direct observation to ascertain children's physical activity levels during breaktimes at school, school physical education lessons and children's leisure time out of school. They reported that children engaged in MVPA for 29.3% of the total time observed. When considering sustained periods of MVPA, only 21% of the sample recorded at least one sustained 20 minute period but in direct contrast, 95% of the children engaged in at least one 5 minute period. Pangrazi et al. (1997) termed childhood activity as being sporadic. Pangrazi and colleagues (1997) also found that although children's heart rates rose considerably it was not for sustained periods of time thus suggesting that a continuously high heart rate is not a good criterion for younger children. Sallo and Silla (1997) also concluded that in 4-8 year-old Estonian children, habitual physical activity was characterised by an intermittent pattern without prolonged periods of MVPA. However, as previously mentioned the benefits of short bouts of physical activity have yet to be substantiated (HEA, 1997). The nature of playground or free play, which is voluntarily participated in during childhood, is intermittent and rarely involves children in sustained physical activity and certainly not in the category of 140 bpm (beats per minute) for ten minutes or more (McNab, 1992). Strong et al. (2005) argues that brisk walking, cycling and active outdoor play normally reach the moderate intensity threshold, yet Armstrong and McManus (1994) found that children have surprisingly low levels of habitual physical activity and that many of these children seldom experience the intensity and duration of activity associated with health-related outcomes.

It has been recognised that from an early age that young people are acquiring inappropriate lifestyle habits resulting in an increased risk of future coronary heart disease (CHD) (Riddoch et al., 1991). The World Health Organisation (WHO, 2004) reported that 60% of the global population fail to engage in the daily minimum recommendation of 30 minutes of moderate intensity activity. In the U.K., there is considerable concern that a significant proportion of both Primary school aged children (Shropshire and Carroll, 1998), and those attending Secondary schools (HEA, 1997), are failing to participate in levels of physical activity sufficient to gain the health benefits previously discussed.

1.5.1 Changes in young people's physical activity

Both physical and social environments that have an impact on the availability of space in which to play, opportunity to participate, and degree of encouragement to engage in physical activity can influence a child's willingness to take part in vigorous levels of physical activity (Johns and Ha, 1999). Sallo and Viru (1996) investigated children's aerobic fitness in relation to activity levels. Both parents and teachers were requested to categorise children's activity levels. It was found that those who were of a higher aerobic fitness were classified as more active by the teacher but not generally active by the parents. Thus, in the home environment children are not as active as they are at school and there is the possibility that increased activity levels in children result in beneficial physiological responses. Additionally, research conducted in Hong Kong observed six to eight year olds at home and during school breaktimes using the Behaviour of Eating and Activity for Children's Health Evaluation System (BEACHES) devised by McKenzie et al. (1991) (Johns and Ha, 1999). It was found that the physical environment limited both home and school-based activity primarily due to the fact that there is a lack of space and facilities adjacent to home environments in Hong Kong and therefore low activity levels persist at school even though the children have access to a school playground (Johns and Ha, 1999). Indeed, research conducted among Belgian adults has suggested that the environment in which people live has the ability to affect physical activity levels (De Bourdeaudhuij, Sallis and Saelens, 2003). De Bourdeaudhuij and colleagues found that both minutes spent walking and time spent in moderate intensity activity was related to the quality of pavements, and accessibility to local amenities and public transport.

However, perhaps more noticeable is the increased range of sedentary leisure time activities available to young people today compared with previous generations (Naughton et al., 2006). It has been suggested that the rise in television and video viewing and the playing of computer games, increased traffic, and the growing fear of parents towards letting their children out unaccompanied have had an impact upon activity levels (Sharp, 1995). Other research has made similar findings and, again as a result of participant observation, adolescents have been found to engage in considerable moderate to vigorous physical activity (MVPA) at certain times, but are less likely to do so at home due to the many sedentary alternatives available to them (Sleap and Warburton, 1992; Sleap and Warburton, 1996). Fox (2003) also made similar observations and indicated that the accessibility and decreasing cost of electronic entertainment has made the home a more attractive place in which to spend time. However, additional research made findings to the contrary. A study conducted in the U.S. by Simons-Morton, Baranowski, O'Hara, Parcel, Huang and Wilson (1990), identified through self-report methods that children participated in significantly greater amounts of moderate to vigorous physical activity (MVPA) during out of school hours than during school; boys reported 1.6 times and girls 1.4 times more MVPA of greater than or equal to 10 min (LMVPA) before and after school than during school. Similarly, the findings of a survey conducted by the Queens University of Belfast in 1990 found that over two thirds of children in Northern

Ireland who responded to a self report questionnaire claimed to be more active during school holidays than term-time (Mahoney, 1995). Due to the fact that physical activity was assessed by means of self-report questionnaire, the accuracy of children's recall during school holiday periods can be questioned as days can lack the structure of school days particularly when reporting time spent in activity. However, it should be noted that more recent research conducted in New Zealand using pedometers found children completed more steps outside of school than during school (Cox et al., 2006) thereby supporting the findings of studies conducted by Simons-Morton et al. (1990) and Mahoney (1995) whereas research conducted in England, again using pedometers, found that primary school aged children are significantly more active during weekdays (in a s chool week) compared to weekends (Duncan, Al-Nakeeb, Woodfield and Lyons, 2007). A more complex pattern of physical activity was observed by Mota, Santos, Guerra, Ribeiro and Duarte (2003) who used accelerometers to measure weekday MVPA patterns amongst Portuguese youth. Mota and colleagues found that boys engaged in more MVPA and were therefore more active after school (i.e. late afternoons and evenings) and girls were more active during school. Therefore, it can be argued that boys' and girls' physical activity patterns on school days differ and research findings which fail to distinguish between genders should be treated with caution.

In Western Society, television watching is a popular pastime amongst young people. P ate, Long and Heath (1994) suggest that television viewing by adolescents consumes a g reat deal of their leisure time. One-third of

American and British youth who participated in a study conducted by Marshall, Biddle, Sallis, McKenzie and Conway (2002) reported watching four or more hours of television per day. Research suggests that children who watch more television are less likely to participate in vigorous physical activity and tend to have higher body mass indeces (BMI) (Andersen, Crespo, Bartlett, Cheskin and Pratt, 1998). However, DuRant, Baronowski, Johnson and Thompson (1994) failed to find strong correlations between hours spent watching television, physical activity and body composition in small children (3-4 years old). It has previously been suggested that sedentary behaviours are generally unrelated to physical activity (Biddle et al., 2004) and among longitudinal analyses no significant relationship between watching television and changes in physical activity has been identified (Pate et al., 1994). In addition, the few hours spent watching TV every day is most likely time when physical activity is probably going to be low and what children watch is related more to their physical activity than the length of time they watch television (Armstrong and Welsman, 1997). Some studies do not take into account additional passive activities such as playing video and computer games which, when added to time spent watching television, encroach considerably on the time available to participate in leisure-time physical activity (Pate et al., 1994). Studies suggest that although the nature of sedentary activity has changed over recent decades the amount of time young people spend in passive leisure time physical activity is much the same now as in previous years (Biddle et al., 2004).

It has been suggested that there is an effective system of social constraint that discourages children from being physically active (Johns and Ha, 1999). Hillman (1993)[5] found that children's freedom to participate in outdoor activities, referred to as children's independent mobility, declined over a period of twenty years. The research, which was conducted in the United States, indicated that boys enjoy greater freedom than girls and that four times as many children were chauffeured to school in 1990 than in 1971. In the UK there also has been a decline in active transport in recent years (Biddle et al., 2004). The fact that increasing numbers of children are being transported to school is most likely due to the belief of many parents that their neighbourhoods are unsafe (Princeton Survey Research Associates, 1994)[6]. The findings of this research are also supported by the work of Fox (2003) who suggests that much of this parental fear stems from media coverage of missing persons, and childhood abuse stories as well as the education pupils receive at school. However, Sleap and Warburton (1996) found that a considerable amount of brisk walking, including walking to and from school, was still undertaken by some young children. Recent studies have found that European children who walk or cycle to school are more active than those who travel to school by motorised transport (Cooper, Andersen, Wedderkopp, Page and Froburg, 2005; Cooper. Page, Foster and Qahwaji, 2003). Obviously, the promotion of active transport as a means of increasing activity levels should be encouraged as previous work has indicated that children engage in limited amounts of physical activity during their leisure time (Sleap

[5] Hillman, M. (1993) One false move … an overview of the findings and issues they raise. In M. Hillman (Ed.) *Children, Transport and the Quality of Life*. London: Policy Studies Institute, p. 7-14. Cited in Armstrong and Welsman (1997)

[6] Princeton Survey Research Associates (1994) Prevention magazine's children's health index. *Prevention*, 46(9): 65-80. Cited in Andersen et al. (1998)

and Warburton, 1996). Furthermore, if more children were walking to school as opposed to being driven then logically the danger posed by road traffic would be lessened.

Although it has been suggested that modern society inhibits the lifestyles of its children (Sleap and Warburton, 1996), research findings to date are equivocal with no single aspect solely responsible for shaping young people's activity habits. If adult health-related activity patterns are determined in childhood, then the falling energy expenditure levels of children give "grounds for considerable concern, both intrinsically and for their adult future" (Sharp, 1995: 54). Sharp (1995) sees that the only way to address this issue is to look at the architecture of our towns and cities, government transport and policing policies to make the streets a safer place, and to provide adequate facilities and trained physical education teachers in both primary and secondary schools. Clearly, no one factor can shape participation in physical activity and involvement in sport (Brustad, 1996)[7]. Indeed, in recognition of the complex nature of young people's physical activity levels, a recent intervention study considered a range of approaches to increasing activity including: daily physical education classes, short activity breaks during academic lessons, activities during school breaks and before and after school, physical activity homework, active transport to and from school, and initiatives to encourage families of the school children to become more active (Zahner, Puder, Roth, Schmid, Guldimann, Phüse, Knöpfli, Braun-Fahrländer, Marti and Kriemler, 2006).

[7] Brustad, R.J. (1996) Attraction to physical activity in urban school children: Parental socialisation and gender influences. *Research Quarterly for Exercise and Sport*, 67, 316-323. Cited in Carr et al. (1999)

The majority of studies conducted over recent years have postulated a decline in young people's physical activity, however, research carried out among Canadian youth suggests that self-reported leisure time physical activity (expressed as average daily energy expenditure) has increased (Eisenmann, Katzmarzyk and Tremblay, 2004). Although the findings of Eisenmann and colleagues provide some evidence to suggest that activity levels are in fact increasing, the authors have attributed this apparent increase in leisure time energy expenditure to a variety of issues. First, people's perceptions of physical activity could have changed with time - for example walking and gardening may not have been considered as physical activities previously and therefore respondents did not report such activities. Second, decreases in non-leisure time activity (e.g. active transport) have been offset by increases in leisure time activity. Third, methodological issues associated with physical activity recall in youth and, specifically in this study, the use of different self-report questionnaires by different cohorts of participants.

1.5.2 Changes in physical activity with age

It has previously been reported that physical activity shows a steep downward trend during adolescence (Biddle, Gorely and Stensel, 2004; Pate, Long and Heath, 1994). Harris (1998) is also in agreement with this and states unequivocally that physical activity declines with age. However, findings to date fail to agree the point at which a decline in physical activity is most marked. In addition, studies use different data collection methods and express physical activity in different ways which makes it difficult to compare the results of research.

The findings of the Northern Ireland Health and Fitness Survey conducted in 1990 (Mahoney, 1995) indicated that after the age of fourteen years students demonstrate a marked decline in physical activity which was predicted to track into adulthood. The Amsterdam Growth Study (Mechelen and Kemper, 1995) also made similar findings. This study tracked physical activity levels over a period of 15 years and observed that between the ages of 13 and 16 years the time spent in activity decreased. However, the study observed that participants' activity increased in their early 20s before decreasing again in their late 20s. More recently, 12-14 year old Canadians have been found to expend more energy than 15-19 year olds (Eisenmann, Katzmarzyk and Trmblay, 2004). Indeed, research indicates that a significant fall in activity occurs much earlier in life than previously thought (Trost, Pate, Sallis, Freedson, Taylor, Dowda and Sirard, 2002). Using objective measures of physical activity in the United States, MVPA during childhood was found to decline sharply between Grades 1-3 (comparable with Key Stage 1 in the United Kingdom) and Grades 4-6 (comparable with Key Stage 2) (Trost et al., 2002). However, further research conducted in North America and using objective physical activity measurement techniques failed to identify any significant decline in activity between the ages of six to twelve years (Vincent and Pangrazi, 2002).

The Queen's University of Belfast (1990), which conducted a survey into the health and fitness of post primary students in Northern Ireland, revealed that only 46% of boys and 30% of girls older than 11 years participated in extra-curricula physical activity. However, it has been previously suggested that the majority of adolescent physical activity is obtained outside of school hours (Pate et al., 1994). Hovell, Sallis, Kolody and McKenzie (1999) conducted research again using self-report techniques and found that both boys' and girls' overall daily energy expenditure expressed as MET scores (one MET is equivalent to resting energy expenditure) decreased significantly from the fourth grade (9-10 years) to the sixth grade (11-12 years) and observed no gender difference in the fall.

Studies generally conclude that, on average, adolescents engage in 0.5-1.5 hours of physical activity of at least moderate intensity per day (Pate et al., 1994). In most cases, 0.5-1.5 hours per day is sufficient to reach the ACSM's (2000) physical activity recommendations for adults. However, very highly active or inactive individuals who create considerable variability around the mean, could effect the data (Pate et al., 1994).

Carroll and Shropshire (1999) identified an opposing trend to that previously identified by Pate et al. (1994). Using an unnamed self-report physical activity questionnaire with a sample of 710 children, Carroll and Shropshire (1999) found that children's level of activity actually increased with age. Results indicated that both boys' and girls' activity levels increased between the last year of primary school (Year 6) and the first year of secondary school (Year

7). Therefore, the drop in activity levels reported in some of the literature does not take place between school years 6 (10-11 year olds) and 7 (11-12 year olds) although this may in part be due to the changes in school (i.e. specialist PE provision and new physical activity opportunities such as a wider range of extra curricular school sport).

It has been suggested that the age related decline in physical activity can be affected by the data collection method used and that, when measured by objective means, such as heart rate monitoring, the decline is two to three times steeper than when self report data are used (Sallis et al., 1998). If this suggestion is to be accepted then an age related decline identified by means of subjective methods of physical activity assessment would therefore be expected to be greater than Hovell et al.'s (1999) study indicates. Interestingly, many studies attempting to measure children's and young people's physical activity levels across year groups have focused on the move from one phase or National Curriculum Key Stage in compulsory education to another. Therefore, physical education and school sport can have an important part to play in the physical activity levels of their pupils.

Pate et al. (1994) concluded that, when compared with adults, adolescents are quite physically active but unfortunately, many adolescents report little participation in structured activity and age trends indicate that considerable numbers of adolescents are at risk of becoming sedentary adults. Although some longitudinal research has been conducted in the area (e.g. the Amsterdam Growth Study, the Muscatine Study), most existing studies tracking physical activity from childhood to adulthood have been based on the recall of childhood physical activity by adults (Brill, Burkhalter, Kohl, Blair and Goodyear, 1989; Dishman, 1994; Powell and Dysinger, 1987[8]). Obviously, this method of collecting physical activity data is questionable because the recall of behaviour over such a long period of time poses problems with the accuracy and reliability of information recalled.

Physical activity should be expected to be "discontinuous in nature" as any number of factors can influence activity behaviour especially major life events such as changing schools, moving home, child rearing, illness, and biological and psychological development (in particular puberty) (Boreham and Riddoch, 2001: 920). Indeed, recently published research findings confirmed that physical activity levels are discontinuous. The study conducted in Northern Ireland revealed that the tracking of physical activity is poor between the ages of 15 and 22 years (Boreham, Robson, Gallagher, Cran, Savage and Murray, 2004). Therefore, it can be suggested that research findings to date paint rather an inconclusive picture regarding activity tracking.

1.5.3 Physical activity and gender

Although there is a considerable level of interstudy variability, it has been consistently observed that females are less active than males (Cale, 1993; Pate, Long and Heath, 1994; Sarkin, McKenzie and Sallis, 1997; Armstrong, 1998; Shropshire and Carroll, 1998; Hovell et al., 1999; Duncan et al., 2007). These findings reflect those of research previously conducted amongst the

[8] Powell, K.E. and Dysinger, W. (1987) Childhood participation in organised school sports and physical education as precursor of adult physical activity. *American Journal of Preventative Medicine*, 3: 276-281. Cited in Trudeau, Lautencelle, Tremblay, Rajic and Shephard (1999).

adult population with an additional finding that women need a higher level of motivation to pursue high activity levels (Killoran, Cavill and Walker, 1994).

Shropshire and Carroll (1998) found that boys spend on average 1.5 hours per week more than girls participating in physical activity and are more likely to participate at higher intensities. Armstrong and McManus (1994) observed from their study of 266, 11 to 16 year olds using continuous heart rate monitoring that, when compared with girls, boys spent a significantly higher percentage of their time with heart rates above 70 to 80% of their maximal heart rate (2.6 vs. 1.4). Raitakari et al. (1997) also found in their study that young females were generally less physically active than young males. The research of Santos et al. (2003), conducted among Portuguese children, used accelerometry as a measure of physical activity and found boys to engage in more periods of continuous MVPA than girls particularly in the 11-13 age bracket. Research studies conducted in England (Duncan et al., 2007) and New Zealand (Cox et al., 2006) using pedometers found that throughout the primary school age range boys completed significantly more steps than girls.

Work conducted in North America using Caltrac accelerometers during school break-times found 10-11 year old boys to have higher activity levels than girls of the same age even though there were similar opportunities for both genders to be physically active (Sarkin et al., 1997). Thus, Sarkin et al. (1997) propose that gender-based peer expectations and norms can influence a child's activity choice. Wold and Hendry (1998) are in agreement and suggest that boys and girls are socialised from an early age to take on different roles, boys adopting the traditional male role characterised by work and girls assuming the female role of being family orientated and expressive.

It has recently been suggested that adolescent girls' participation in physical activity is influenced by the media's portrayal of females (Biddle and Mutrie, 2007). Themes emerging from the study included the amount of media coverage of females in sport and the media's representation of the ideal female being "thin and beautiful" (Biddle and Mutire, 2007: 49). Young people learn that the role of the athlete is very different from the roles associated with being a female and that competition and achievement can be considered more masculine role values than feminine (Wold and Hendry, 1998). Netball and hockey, stereotypical female sports, carry less prestige than soccer and rugby thus reinforcing the relative unimportance of physical activity to women and young girls (Armstrong and McManus, 1994). Mahoney (1995) is of the opinion that young females should not be stereotyped into specific activity areas, moreover, PE programmes should be developed to provide opportunities for girls to participate in activities which are not restricted to those classified as feminine and therefore challenge gender stereotypes.

Research has also attempted to establish if choice of PE activity (Prusak, Treasure, Darst and Pangrazi, 2004) and the nature of the activity (individual or team sports) (Hodges Kulinna, Martin, Lai, Kliber and Reid, 2003) have any affect upon participation. The findings of Prusak et al. (2004) suggested that choice in PE can indeed result in increased motivational levels to adopt a physically active lifestyle both through adolescence and into adulthood. Heart rate data collected amongst a sample of North American elementary and secondary pupils revealed that the physical activity levels of girls were highest when engaged in individual activities such as gymnastics, dance and weight training whereas boys were more active during team sports such as basketball and soccer (Kulina et al., 2003). Thus, it can be suggested that giving pupils, especially girls, the choice to take part in certain activities during physical education lessons results in increased physical activity levels both in the short and long term.

However, research has again produced conflicting findings with some studies finding no marked difference in activity levels between boys and girls. Over a three-day period, 12.3% of boys and 13.3% of girls in the third and fourth grade in the United States reported no MVPA of 10 minutes or more (Simons-Morton et al., 1990). Similarly, over four days of heart rate monitoring, Sallo and Silla (1997) found no gender difference in physical activity levels of 4-8 year old children in Estonia. Sleap and Warburton (1996) found very little difference in activity levels between prepubescent boys and girls and a review of research conducted with secondary-aged children suggested that the drop-off in participation occurs after the age of 11 years (Cale and Almond, 1992b). Indeed, research has found that male habitual physical activity levels decline more rapidly than those of their female peers (Gavarry, Giacomoni, Bernard, Seymat and Falgairette, 2003). In this study it was found that between childhood and adolescence, the activity levels of male subjects fell by 69% compared with 36% for females.

After reviewing previous research findings, Pate et al. (1994) state that activity levels decline with age during childhood and adolescence. Research conducted by Armstrong and McManus (1994) found that there was no significant relationship between age and physical activity for boys. However, a negative correlation with age was found for girls. Therefore, not only are boys more active than girls, but girls' activity levels deteriorate more rapidly as they move through secondary school (through adolescence) (Armstrong, 1998). Sallis (1993)[9], reported that male activity levels decline at a rate of 2.7% per year whereas female activity falls by about 7.4% per year. Conversely, more recent research has suggested that the trend is reversed and it is indeed boys' physical activity which declines more rapidly during youth (van Mechelen et al., 2000). However, the work of Santos et al. (2003) did not support either of these findings and indeed results failed to show any age related decline in the amount of time spent in MVPA.

In research conducted by Ilmarinen and Rutenfranz (1980)[10], it was found that there was a dramatic drop in the physical activity of adolescents after leaving a school system where PE had been compulsory. The Amsterdam Growth Study also obtained similar results (Kemper, Mechelen, Post, Snel, Twisk and Welten, 1995). This longitudinal study conducted in the Netherlands with subjects initially aged 13 years discovered that over a 15 year period, activity levels fell dramatically. In males, activity levels over the total period fell by 42% and most of this drop occurred during the first five years of the

[9] Sallis, J.F. (1993) Epidemiology of physical activity and fitness in children and adolescents. *Critical Reviews in Food Science Nutrition,* 33: 403-408. Cited in Cale (1996)

[10] Ilmarinen, J. and Rutenfranz, J. (1980) Longitudinal studies of the changes in habitual activity of schoolchildren and working adolescents. In K. Berg and B.O. Eriksson (Eds.) *Children and Exercise IX.* University Park Press: Baltimore. Cited in Trudeau et al. (1999)

adolescent period (13-18 years of age). The activity levels of females from the study also dropped but only by 17% over the same period. However, it is important to consider that given the research findings previously discussed female physical activity levels during childhood and adolescence are at a lower level than those of their male counterparts.

Cale (1996) conducted research amongst 11-14 year old adolescent girls in Britain using the Four by One-Day Recall Questionnaire where physical activity type, intensity and duration were reported. After classifying respondents into categories according to activity scores, a staggering 78.6%, over three quarters, of girls were found to be either inactive or very inactive and only one fifth reported to be moderately active or active. In addition, almost half of the girls (45.6%) were found to have engaged in no vigorous activity over the four days reported. Thus, research indicates that irrespective of age and method of data collection, boys engage significantly more in physical activity than girls.

1.5.4 Physical activity, ethnicity and race

According to Verma, Zec and Skinner (1994) many misconceptions exist concerning the size, growth and composition of ethnic minority groups living in the United Kingdom and they suggest that it is important to consider that half of the ethnic minority population were born in Britain and nearly three quarters are British citizens. Furthermore, many young people see themselves belonging to two or three communities – or none at all (Verma et al., 1994). There are also minority groups who are overlooked such as those of

European origin, for example Poles, Italians and Cypriots, who fail to appear in census data and research relating to ethnic minorities (Verma et al., 1994). According to the census data of 1991, approximately three million people from ethnic minority groups lived in Great Britain. However, recently published data from the 2001 census suggests that the minority ethnic population of England and Wales is growing. In excess of 4.5 million people from ethnic minority groups live in Britain and over half of these are Asian or Asian British and in excess of one million from Black or Black British ethnic groups (National Statistics Online, 2006).

It has been stated that the terms race and ethnicity are socially constructed and that the distinction between the terms is a subjective matter (Blakemore and Boneham, 1994). Nevertheless, the terms race and ethnicity can be very confusing when used interchangeably (Chapell, 2002; Coakley, 1998) primarily due to the fact they have different but related meanings (Malina, Bouchard and Bar-Or, 2004; Blakemore and Boneham, 1994). The distinction between race and ethnicity can be particularly confusing as different races can have “a unique ethnic culture” (Stroot, 2002: 140). In an attempt to clarify the differences between the terms race and ethnicity, race can be defined as “a category of people regarded as socially distinct because they share genetically transmitted traits believed to be important in the group or society” (Coakley, 1998: 249). However, Malina and colleagues (2004) recognise that humans are more genetically similar than dissimilar although populations do differ in genetic characteristics and differ visibly in a phenotypical feature. Such visual differences include skin pigmentation, hair texture, facial features and stature (Figueroa, 1993). It is these physical markers which can categorise and socially define individuals in a given society to a certain race (Cashmore, 1994). Coakley's (1998: 250) definition of ethnicity refers to the "cultural heritage of a particular group". Therefore, ethnicity refers to commonalities, such as shared language, religion and traditions, other than biological features (Chappell, 2002; Stroot, 2002).

Although researchers within the social sciences have begun to use the term ethnicity (Chappell, 2002), there is a tendency to use the term race to describe a social group defined by somatic visibility (Cashmore, 1994). Furthermore, health researchers tend to adopt a positivist approach whereby people can be grouped according to indicators (such as skin colour, nationality or religion) which are unquestioned constructs (Pfeffer, 1998). It has previously been suggested that phenotypical markers are still popular as a method of organising people into social groups as they are more obvious than other potential commonalities (such as cultural differences) because they are part of everyday commonsense knowledge and ideology (Polley, 1998; Pfeffer, 1998). Pfeffer (1998) highlights that investigators construct their own categories or adopt categories from official surveys (such as national censuses) for pragmatic reasons whereby there is essentially at least one set of characteristics shared by everyone in a certain category.

According to Laker (2002: 2) a culture is "a system of shared values, meanings and symbols" which is socially derived. As humans can differ in phenotypical appearance so can they differ in culturally determined habits, attitudes, and behaviour patterns (Malina et al., 2004). Nevertheless it is important to consider that culture is a broad term referring to a number of shared symbolic and cognitive systems, languages, beliefs, values, religions, way of life, and social institutions (Figueroa, 1993). Ethnicity is therefore a broader concept which includes culture as well as other components of ethnic identity such as a shared history or land of origin (Rowland, 1991)[11]. However, a postmodernist approach does not fix people into categories. In an attempt to overcome essentialism, postmodernism recognises that increasing numbers of racially diverse people live in the same geographical location (globalisation) and "feel a sense of belonging" to each other" (Pfeffer, 1998:1384).

Chappell (2002) acknowledges that many individuals, for example people with mixed parental heritage, cannot be neatly assigned to ethnic or racial categories. Therefore, ethnic identity is changeable and a person's own perception of themselves and the degree to which an individual adopts the beliefs and behaviours associated with a particular ethnic group can vary. Acculturation is "the process by which individuals integrate the customs, attitudes, and habits associated with their traditional cultures with those of the dominant culture" (Kawamura, 2002: 247). The process of absorbing the host or mainstream culture is affected by the degree to which an individual associates with their traditional culture(s). Thus, the acculturation of one South Asian British National male can be very different from another South

[11] Rowland, D.T. (1991) Pioneers Again: Immigrants and Ageing in Australia. Australian Government Publishing Service, Canberra. Cited in Blakemore and Boneham (1994)

Asian British National male due to a variety of reasons including their ethnic identity, use of language, number of generations in Britain and social group.

Limited physical activity research has been conducted with different ethnic groups but more information is available with regards to adult groups of differing ethnicities than for young people. Nevertheless, the HEA (1998) identifies cultural factors as a determinant of physical activity and ethnic background and upbringing as having an impact upon lifestyle and therefore physical activity.

With reference to British national averages, death rates from coronary heart disease are higher among South Asians and death rates as a result of strokes are higher among African-Caribbeans (Rai and Finch, 1997). It is widely accepted that physical activity can play a preventative role and help to control these diseases but most people from the aforementioned population groups do not participate in sufficient physical activity to benefit their health (Rai and Finch, 1997). Two studies conducted in the United States within the adult population found similar results even though different methods of data collection were used in different states. Data collected by Folsom, Cook, Sprafka, Burke, Norstead and Jacobs (1991) using leisure-time physical activity questionnaires and the findings of Washburn, Kline, Lackland and Wheeler (1992) by means of telephone interviews revealed that black people have lower participation rates than whites. In addition, a higher percentage of US white adults participated in leisure-time physical activity (49%) than did all other race groups (Folsom et al. 1991).

With reference to research conducted in the United Kingdom, an analysis of data from the General household survey (GHS), revealed that 65% of white people compared with 59% of people of Afro-Caribbean origin, 50% of Indian origin and 37% of those originating from Pakistan had participated in organised physical activity once in the last four weeks (Sports Council, 1994). However, this study was a large-scale normative study with relatively small sample sizes for black and ethnic minority communities and therefore findings should be treated with caution. Extensive research conducted by Verma, MacDonald, Darby and Carroll (1991) identified some marked ethnic and gender differences in leisure and sporting activities. It was found that a quarter of all Bangladeshi, West Indian and Pakistani males took part in no sport or recreational physical activity compared with a much lower overall male value of 15%. Similarly, comparable non-participation figures were almost twice as high for females; almost 50% of Bangladeshi and Pakistani women compared with 29% overall.

More recently, Fischbacher, Hunt and Alexander (2004) reviewed research carried out in the UK amongst adults of South Asian heritage and reported that of the twelve studies identified all found Indian, Pakistani and Bangladeshi ethnic groups to be less active than the general population. However, Fischbacher et al. (2004) raised concern regarding the measures used to determine physical activity; specifically issues regarding validity, translation and adaptation.

Findings from research published by the Sports Council offer some explanation for these differences. This research indicated that in the UK there is a tendency for members of the Asian community to relegate the importance of structured physical activity below work, education, religious duties and family life (Sports Council, 1994). This notion is supported by Rai and Finch (1997) who reported that members of black and South Asian communities have been found to place exercise as a low priority when using whatever spare time they had left after the demands of work, household management, childcare and religious activities (Rai and Finch, 1997). However, contrastingly, Rai and Finch (1997) acknowledge that there are no cultural or religious reasons prohibiting members of South Asian or black communities from participating in physical activity although they did identify some common structural barriers to participation in activity. Respondents to interviews identified cost, location, opening hours, dress code, mixed-sex facilities and the cultural environment as barriers to participation (Rai and Finch, 1997). Nevertheless, the needs of people from England's black and ethnic minority communities have to be considered when promoting a physically active lifestyle due to the fact that important elements, such as culture or religious denomination, can present additional barriers to physical activity participation (Killoran, Cavill and Walker, 1994).

There is the need for modesty among Asian females resulting in many only participating in sport in an all-women environment (Asian women and sport, 1988 cited in Sports Council, 1994). This is particularly a concern for older Asian women and many Asian Muslim women as they are unable to use sporting facilities because they feel they ought to change into clothing which is inappropriate for them (Rai and Finch, 1997). This need for modesty can also relate to the findings of The General Household Survey (GHS) (1992) which indicated that participation rates in indoor fitness activities were greater among women than men. However, the findings of studies reviewed by the Sports Council (1994) would suggest that black and ethnic minority women formed a small group of these women. In addition, members of ethnic minority groups are also aware of stereotypes which effect participation in physical activity. South Asian respondents believed they were perceived to lack physical strength to engage in competitive sports and that Asian women were housebound whilst black people felt they were pushed into particular sports and that the population in general perceived them to be fit people (Rai and Finch, 1997).

In criticism of a study carried out by Carrington et al. (1987) and conducted among ethnic groups in the UK, Raval (1989) revealed that the writers failed to gain an understanding of the leisure experiences of women of South Asian descent due in part to them being white male academics. Unfortunately, much of the research conducted in this area has been carried out by white males thus failing to challenge assumptions and racial chauvinism. Furthermore, researchers fail to acknowledge that South Asian women are subjected to the patriarchy of their own culture, as well of that of the predominantly white society, which is reflected in their leisure behaviour (Raval, 1989).

With reference to research conducted amongst young people of different ethnicities the evidence base is less extensive. Research conducted in the United States has revealed both ethnic and gender differences in young people's physical activity engagement (Sallis et al., 1998). Sallis et al. (1998) found that Anglo American children expended significantly more energy than Mexican American children. The findings of a more recent studies conducted in the U.S. found that the prevalence of physical activity is lower among young people from ethnic minority groups (McGuire, Neumark-Sztainer and Story, 2002; Eisenmann, Bartee and Wang, 2002). It has been found that rates of inactivity are particularly high among not only adolescent girls but also non-Hispanic blacks and Mexican American children (Andersen et al., 1998). Andersen and associates (1998) also identified a relationship between sedentary activity (i.e. hours spent watching television) and both BMI and skinfold thickness. One quarter of all U.S. children watch television for four hours or more per day, however, 43% of non-Hispanic black children watch more than four hours worth of television (Andersen et al., 1998). Therefore, ethnic minorities who in general accumulate more hours of watching television are fatter than those groups who watch less TV and are at greater risk from lifestyle related diseases which are linked with overfatness and obesity (HEA, 1998). Longitudinal research conducted in the U.S. found that African-American girls aged 11-14 years had lower VO_{2max} values than Caucasians (Pivarnik, Taylor and Cummings, 1998). Because Pivarnik et al. (1998) only assessed aerobic fitness and did not research the anatomical, physiological and behavioural reasons behind the lower aerobic fitness of African-Americans, they suggest that further research should be conducted in this area. More recent research, again conducted in the US found that moderate to vigorous activity was lowest for non-Hispanic black girls and Hispanic girls and overweight status was highest among these groups as well as Hispanic boys (Gordon-Larsen, Adair and Popkin, 2002). Thus, it is suggested that differences in physical activity patterns amongst North American children from ethnic minority groups can have an impact upon their health related fitness. Research conducted in South Africa has also found racial differences in physical activity patterns (McVeigh, Norris and de Wet, 2004) which support the findings of studies conducted in North America. McVeigh et al. (2004) found white children to be more active, more likely to participate in PE and watch less TV than black children.

Limited research has been conducted amongst a British population and there tends to be a focus upon physical education and school sport. Carroll and Hollinshead (1993) state that little research has been conducted dealing with the issues of teaching ethnic minority groups in physical education (PE). In their study, Carroll and Hollinshead conducted interviews with South Asian Muslim children and their PE teachers to examine issues and conflicts. It was found that the children had to play two roles: one as a Muslim child and the other trying to fit-in in a Westernised community. Children were torn between school policy and religious practices and the following areas of conflict were highlighted: PE kit, showers, Ramadan, and extra-curricular activities. However, according to Scraton (1992) the problem is not the cultural diversity of pupils in British schools it is the ethnocentrism of schooling and individual and institutional racism. Scraton (1992) continues to recommend that future work be conducted to establish the relationship between race, class and gender within physical education and specifically research which considers the experiences of black young women in the teaching of girl's physical education.

The findings of research related to activity behaviours in children, imply that ethnic differences (McKenzie, Sallis, Nader, Broyles and Nelson, 1992) as well as parental modelling (Sallis, Patterson, McKenzie and Nader, 1988) influence a child's activity levels. Therefore, it is suggested that low parental physical activity behaviour amongst adults from the ethnic minorities is reflected in the child's activity patterns.

In elite level sport there exists a different pattern of involvement than at the recreational level. Afro-Caribbean male representation is greater than Asian male involvement and Afro-Caribbean and Asian female involvement. For example a considerable proportion of all professional football players are Afro-Caribbean and black males are well represented in various other sports (Collins, 2003), for example track and field athletics, boxing, cricket and basketball. Indeed, in the U.S. it has previously been reported that blacks are overrepresented in the professional sports of basketball, American football and baseball (Coakley, 1998). However, it is often overlooked that even in the past decade black groups have been underrepresented or non-existent in many professional sports at most levels of competitions in both the UK and US (Collins, 2003; Coakley, 1998). Similarly, some Asian sportspeople have achieved international success in hockey, cricket and squash (Chappell,

2002) but there is a distinct lack of top level Asian sportswomen in British sport (Sports Council, 1994). Because there is the tendency to consider those sports with many black participants, people forget that there is a virtual absence of black, as well as South and East Asian athletes in other sports with a white majority dominating several sports (e.g. motor racing, skiing, badminton, bowling, canoeing/kayaking, cycling, swimming, diving, equestrian events, tennis, volleyball, yachting, Coakley, 1998; Melnick, 2001).

Carrington (1982) highlighted the overrepresentation of black pupils in school sports teams as being the outcome of teachers who view this ethnic group as having skills of the body rather than skills of the mind. It is argued that the abundance of black males in top-flight sport can be linked to genetically attributed physiological advantage. However, it has been suggested that the education system can influence the success of black people in sport. Teachers believe it is of benefit for young black people to be successful in sport and this may indeed be the case, but at the expense of other aspects of the pupil's academic profile (Hayes and Sugden, 1999). Yet, Cashmore (1982) is more positive and believes that physical education provides opportunities for all students to try a variety of activities as sources of self-realisation and is of the opinion that the reasons why black children get involved in sport are multiple. Hayes and Sugden (1999) refer to an Office for Standards in Education (OFSTED) report from 1996 which concluded that African Caribbean young people, especially boys, have failed to demonstrate increased rates of achievement and in certain areas of the curriculum performance has worsened. Hayes and Sugden (1999) question whether stereotyping in sports and physical education has made a contribution to this worsening situation. In response to this question, Physical Education teachers who taught in mixed race schools were interviewed and a number of findings were made: 49% of respondents agreed that black pupils were disproportionately successful at sport, 82% felt that black pupils were in some way advantaged in sport and 74% of the respondents attribute this success to physiological advantages such as speed, strength, power and agility (Hayes and Sugden, 1999).

Chappell (2002) states that it has previously been suggested that Asian parents living in Britain do not actively encourage their children to become involved in sport as success in academic subjects is perceived to be very important. With particular reference to Asian females living in the UK, there has been additional cultural pressure about revealing their bodies (Collins, 2003). In addition a distinct lack of Asian role models in sport can reinforce a parent's view that sport is not serious and hinder young Asians from pursuing sport (Chappell, 2002).

Coakley (1998) suggests that the abundance of Black sportsmen harks back to the US colonies when black physicality and physical skills were seen as signs of intellectual inferiority and arrested development by white Europeans and Americans. This concept implied that mental traits were superior to physical traits and thus white populations were superior. In 1992, the Sports Council adopted a policy of racial equality in sport acknowledging that inequality in terms of disadvantage and discrimination exists. The Sports

Council (1994) recognises that sport does not treat black and ethnic minority people equitably and that there is a need for positive action to increase black and ethnic minority involvement in sport, and it can be argued physical activity, at all levels.

1.5.4.1 Ethnicity and socio-economic status and physical activity

The engagement in the vast majority of physical activities and sport results in financial costs including clothing, equipment, fees and travel (Collins, 2004). Therefore, a disparity between rich and poor exists. Consequently, those stratified into lower socio-economic status groups will have restricted leisure spending opportunities and, therefore, will not engage in as much leisure time activity as those with more disposable income. Collins (2004: 729) continues to highlight that what poverty does is "exacerbate other forms of exclusion" including exclusion amongst the ethnic minorities.

Black and ethnic minorities are disadvantaged in education, employment, housing and the legal system (Sports Council, 1994) and South Asian and African Caribbean people living in Britain are more likely to be unemployed and to have jobs of lower pay and status than their white counterparts (Brown, 1984)[12]. Indeed, 2001 Census data indicated people from minority ethnic groups were more likely than white people to live in low-income households (National Statistics Online, 2006). Furthermore, certain ethnic minority groups were much more likely than other groups to be living in low-income households; for example, almost 60% of Pakistanis and Bangladeshis. The

[12] Brown, C. (1984) *Black and White Britain: The Third PSI Survey.* London: Heinemann Educational Books. Cited in Figueroa (1993)

Sports Council (1994) concluded that socio-economic status is a major influence on sport participation due to the fact that the majority of black and ethnic minorities are stratified in lower socio-economic groups.

A study where predominantly Caucasian children from families considered to be financially able were questioned by self report about their physical activity choices, intensity levels and time spent in activity found both boys' and girls' physical activity levels to be worrying (Hovell, Sallis, Kolody and McKenzie, 1999). However, Hovell et al. (1999) suggest that, based upon their findings, there is the likelihood that children from less financially advantaged backgrounds are at a higher risk of declining physical activity.

Andersen et al. (1998) provide a possible explanation for lower levels of leisure time physical activity amongst black and minority groups. They found that in the US non-Hispanic black and Mexican children reported a higher prevalence of television watching and lower bouts of vigorous activity than other ethnic groups. Andersen and coworkers (1998) explain this in terms of minority populations being more likely than Caucasians to report their neighbourhoods as being unsafe and therefore less conducive to childhood street play. Ultimately, physical activity levels are limited by the environment in which many black and ethnic minorities live, i.e. inner city neighbourhoods with deficient sports facilities and space for free-play (Sports Council, 1994). Amongst Belgian adults, it has previously been found that socio-economic status was related to a more 'activity friendly' environment (De Bourdeaudhuij, Sallis and Saelens, 2003). Moreover, the Belgian study found that perceived safety from crime was also associated with physical activity levels, with those in higher socio-economic groups engaging in more activity. Therefore, there are limited opportunities to engage in physical activity among those in ethnic minority groups which inhibits future physical activity or sports participation.

Research by Shropshire and Carroll (1997) identified no association between children's activity levels and socio-economic status as the children move from Year 6 into the first year of secondary school, Year 7. However, it was hypothesised by the authors that as children reach adolescence, and they are unable to meet the criteria for child concessions, youngsters from lower socio-economic groups will be unable to participate in as much leisure-time physical activity (Shropshire and Carroll, 1997). However, this research was conducted with an emphasis on socio-economic groups and not ethnicity.

1.5.5 Physical activity and health related fitness

The benefits of physical activity to health and well-being have already been discussed in the literature review, that said, further discussion of the associations between physical activity and the components of health-related physical fitness is provided. The component most strongly linked with health is cardiovascular endurance, or aerobic fitness, which can be defined as the ability to sustain whole body activity at moderate intensity for an extended period of time (Riddoch and Boreham, 2000). Aerobic fitness is strongly and negatively associated with adult mortality and studies have demonstrated that people who are physically active have a lower risk of coronary heart disease (CHD) than those who are not (Riddoch, Mahoney, Murphy, Boreham and

Cran, 1991). In research conducted by Raitakari et al. (1997) many beneficial relationships between physical activity and CHD risk factors such as obesity were found. However, there is no evidence to suggest that children's aerobic fitness is any lower than in previous generations or showing signs of deterioration over time (Armstrong, McManus, Welsman and Kirby, 1996). Indeed, it has previously been suggested that aerobic fitness has not changed markedly for six decades (Armstrong and Welsman, 1997). The majority of the 10-11 year old children who participated in the Armstrong et al. (1996) study failed to achieve the recommended frequency, duration and intensity of physical activity stipulated by Sallis and Patrick (1994) yet all the children, with the exception of two boys, demonstrated a level of aerobic fitness above the health thresholds for boys and girls. Similarly, Armstrong, McManus and Welsman (1994) found that there is very little evidence to suggest that British children are unfit and claim that only 3% of the children tested in their laboratories scored below the health risk level. However, a positive link between children's activity (reported by classteachers) and aerobic fitness has been found with higher levels of aerobic endurance among more active children (Sallo and Viru, 1996). More recently, it has been reported that only weak to moderate positive relationships exist between physical activity and measures of aerobic fitness (Strong et al., 2005).

The above findings only go to suggest that cardiovascular fitness, as other components of physical fitness, are largely genetically determined but can be improved as a result of regular aerobic activity (Riddoch and Boreham, 2000: 924) and, as a result, it has been advocated that there should be an increased focus on children's fitness as evidence suggesting that fitness is related to health "without being mediated by physical activity". However, Armstrong, McManus and Welsman (1994) suggested that children's current pattern of physical activity indicates that they seldom experience the levels of physical activity necessary to make a major contribution to peak VO_2 and Armstrong et al. (1994) claim that intermittent activities of short duration do not result in an increase in maximal oxygen uptake.

Currently, one of the most popular areas of health research is overweight and obesity due to the "growing concern about the prevalence of obesity in Great Britain" (Jebb, Rennie and Cole, 2003: 461) as obesity and physical inactivity are two of the most prevalent chronic disease risk factors (Bouchard, 2000; HEA, 1998). More critically, there is an increasing prevalence of overweight and obesity among children (aged 5-10 years) and that the rate of increase has "accelerated over the last decade" (Stamatakis, Primatesta, Chinn, Rona and Falascheti, 2005: 1002). It has been previously reported that obesity is more common in older children and adolescents than younger children, therefore, there are concerns about the health of future generations particularly due to the long term effect of obesity on cardiovascular health (Reilly and Wilson, 2006). Using the results of a 20 metre shuttle run test, Raudsepp and Jurimae (1998) found that the leanest group of preadolescent boys and girls performed significantly better in the test and participated in more MVPA than the fattest group of children. The study also identified that the fattest children participated in insufficient amounts of MVPA such as sports, games and leisure time activity. The findings of this study would suggest that if children were to increase their activity levels, body fatness would decrease and aerobic fitness would increase and therefore, lead to positive changes in fitness and health.

Muscular strength and endurance are also important components of physical fitness (Strong et al., 2005) as sufficient muscular strength and endurance are required "to perform a wide range of daily tasks without undue fatigue" (Armstrong and Welsman, 1997: 137). FitzGerald, Barlow, Kampert, Morrow, Jackson and Blair (2004) acknowledged that the mortality risk of muscular strength and endurance had not been thoroughly examined and conducted a study to establish whether a dose-response relationship exists. FitzGerald and associates found that, among adults, mortality rates were lower for individuals with moderate/high muscular fitness compared to individuals with low muscular fitness. Indeed, the HEA (1998) acknowledged the significance of components other than cardiovascular endurance and body fat by including participation in activities that enhance muscular strength and flexibility and bone health as one of the recommendations for young people's physical activity. It has previously been advocated that young people should be encouraged to take part in a range of activities to enhance health (Strong et al., 2005) as early specialisation in any one aspect of health-related fitness "is unlikely to promote lifetime commitment to a balanced programme of physical activities" (Armstrong and Welsman, 1997: 151).

It is also important to consider whether fitness levels influence physical activity levels. Previous research has established some association between physical activity levels during PE lessons and cardiovascular fitness and body composition (Fairclough, 2003). This research, conducted in the UK amongst secondary school aged girls using heart rate data, revealed that body fat significantly predicted variance in activity during PE lessons with a negative correlation found. Therefore, girls with a greater subcutaneous fat were less active during the lesson. However, no association between cardiovascular fitness and physical activity was found.

The merits and limitations associated with the measurement of the various components of health-related fitness will be discussed later.

1.6 Young people's attitudes towards physical activity and physical education

It has previously been suggested that there are two main barriers preventing people from participating in physical activity: barriers of a practical nature and barriers relating to attitude and belief (Rai and Finch's, 1997). According to Hagger, Cale and Almond (1997) attitude is the one variable that has had an important impact on the study of physical activity behaviour. Goudas and Biddle (1993) discussed research that had focussed on motives for participation in physical activity and found that fun and enjoyment emerged as major motives. However, enjoyment of physical activity is a broad concept with multiple determinants (Goudas and Biddle, 1993) although some links with attitude theories can be made.

1.6.1 What are attitudes?

According to Eiser (1992) attitude is the most commonly used term in social psychology. Attitude is "a relatively enduring organisation of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols. A general feeling of evaluation – positive or negative – about some person, object or issue" (Hogg and V aughan, 1998: 116). Furthermore, attitude has been defined more succinctly as a subjective evaluative experience which can be c ommunicated (Eiser, 1992). N ot only are attitudes communicated, they can also predict future behaviour, therefore, our attitudes predispose us to act the way we do (Eiser, 1994). Thus, definitions indicate that attitudes are relatively permanent and persist over time and formed of a cluster of feelings, likes and di slikes (Hogg and Vaughan, 1998). Attitudes are learned from experience or from other people (Doganis and Theodorakis, 1995).

Attitude-behaviour models of involvement in physical activity are made up of two components. The attitudinal component is comprised of individual beliefs and values and the normative component is concerned with the extent to which one wishes to comply with the beliefs of significant others (Biddle, 1994). B eliefs can be either positive or negative (Silverman and Subramaniam, 1999). Therefore, if an individual holds a positive belief about an object such as physical activity a more favourable attitude follows and this will have some influence on behaviour (Biddle and Mutrie, 2007). Thus, these components are predictors of intentions and behaviours in physical activity. It is accepted that the tracking of behaviour and attitude occurs from childhood to adulthood (Mahoney, 1995). Therefore, if people are inactive as children they will most likely be inactive as adults due to attitudes held towards physical activity during their younger years. However, it is important to acknowledge that attitudes are not permanent and can change or be changed (Eiser, 1994).

Rosenberg and Hovland (1960)[13] proposed that attitude should be considered as a complex of three classes of components (a three-component model) and not as a single concept. Here the three components; affect (e.g. feelings, emotions), cognition (e.g. beliefs) and behaviour (e.g. overt actions), can sometimes cohere with each other and then sometimes not (Eiser, 1994). However, it is the opinion of Eiser (1994) that a more successful solution was proposed by Ajzen and Fishbein (1980)[14]. The theory of reasoned action (TRA) (represented in Figure 2) (Ajzen and Fishbein, 1980) suggests that attitudes should not be expected to predict behaviour and that it is intention which should be predicted. The theory also proposes that intention is not only influenced by attitude, the extent to which an individual believes that the way in which he or she acts will gain approval or disapproval from significant others such as family, friends and in the context of young people, their teachers also pays an important part. This is termed your subjective norm. Therefore, your subjective norm pulls you in one direction and your attitude pulls you in an opposing direction.

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[13] Rosenberg, C.I. and Hovland, M.J. (Eds) (1960) Attitude Organization and Change, Yale University Press. Cited in Eiser, J.R. (1994)
[14] Ajzen, I. And Fishbein, M. (1980) Understanding Attitudes and Predicting Social Behaviour. Prentice Hall. Cited in Eiser, J.R. (1994)

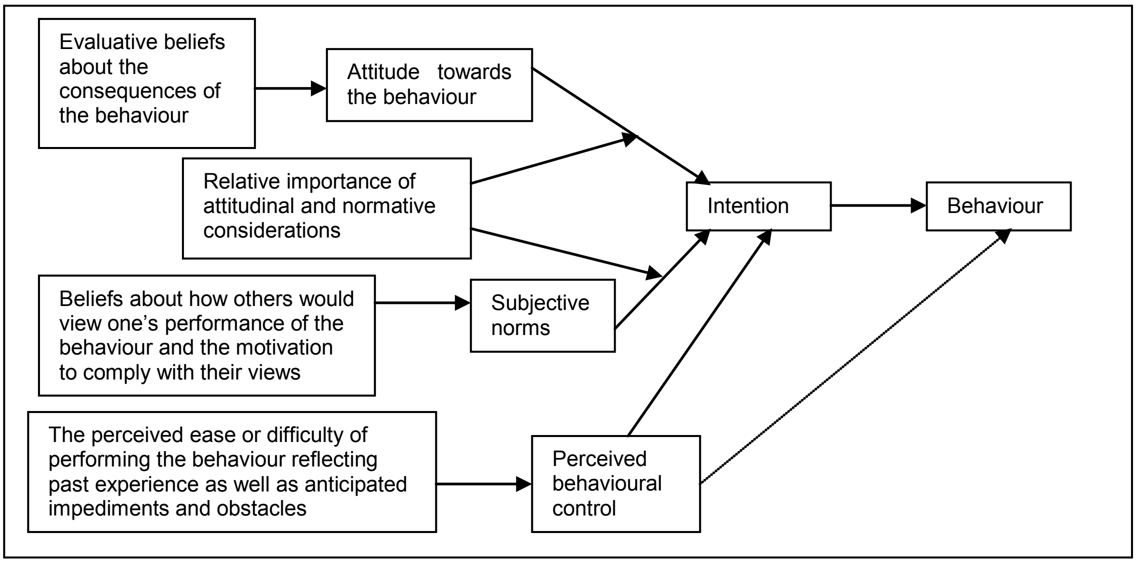

Figure 2. The theories of reasoned action (excluding perceived behavioural control) (Ajzen and Fishbein, 1980) and planned behaviour (including perceived behavioural control) (Ajzen, 1988)

It is important to recognise that the TRA has previously been criticised as the theory does not consider behavioural barriers which prevent the behaviour being totally volitional (Biddle and Mutrie, 2007). For example, an individual's income, working hours and responsibilities to others can impact upon their behaviour and therefore their participation in physical activity or exercise. Subsequently, the TRA was revised to include perceived behavioural control (Ajzen, 1988[15]) which takes into account perceived obstacles to performing the behaviour.

[15] Ajzen, I. (1988) *Attitudes, personality and behaviour*. Milton Keynes: Open University Press. Cited in Biddle, S. J. H. and Mutrie, N. (2007).

1.6.2 Attitude towards physical education and its association with physical activity

It has previously been acknowledged that young people's activity occurs in a variety of settings including PE and school sport (Fox and Harris, 2003). However, PE and the school environment alone cannot meet the physical activity needs of all young people (Cale and Harris, 2005). Nevertheless, there is an assumption that the primary goal of physical education is to promote lifelong physical activity (Corbin, 2002). According to Sallis and McKenzie (1991)[16], physical education has the potential to encourage physical activity outside school and previous attitude research has reported that attitudes towards participation in physical activities outside of school can be attributed to students' attitudes towards PE (Carlson, 1995; Portman, 1995; Ennis, 1996). Thus, an individual's attitude towards PE can be inferred from either verbal or non-verbal responses and actions (Silverman and Subramaniam, 1999). Sleap and Warburton (1992) maintain that with reference to future participation in physical activity, positive attitudes to participation need to be fostered so that physical activity continues through adulthood. Moreover, a good attitude toward physical education is an important component in promoting an active lifestyle in young people (Silverman and Subramaniam, 1999). The duration that a young person remains at the positive end of the attitude continuum increases the intensity of the affective evaluation (Fishbein and Ajzen, 1975[17]). The work of Pease and

[16] Sallis, J. and McKenzie, T. (1991) Physical Education's role in public health. *Research Quarterly for Exercise and Sport,* 127: 933-941. Cited in Shropshire, Carroll and Yim (1997)
[17] Fishbein, M. and Ajzen, I. (1975) *Belief, attitude, intention and behaviour: An introduction to theory and research*. Reading, MA: Addison –Wesley. Cited in Silverman and Subramaniam (1999)

Andersen (1986[18]) and McIntosh and Albinson (1982[19]) found that young people's attitudes are formed before 10 to 12 years of age and between 13 to 14 years of age respectively. In addition, qualitative research conducted among British adolescents revealed that participation in community sport programmes was influenced by previous experiences in PE (Coakley and White, 1992). Therefore, having a positive attitude towards PE is important for the formation of future attitudes towards physical activity and exercise.

School physical education is an arena where sport and physical activity are presented to almost all children and adolescents (Carr, Weigand and Hussey, 1999) and where physical educators are well-placed to foster more active lifestyles (Armstrong and McManus, 1994). With this is mind, Cale and Harris (2005) outline the many government (e.g. Specialist Sports Colleges, Healthy Schools Programme) and non-government (e.g. TOPS Programmes, Jump Rope for Heart) school based physical activity interventions. The advantage of school based initiatives is that they become whole school concerns and are embedded in the school curriculum (Stone, McKenzie, Welk and Booth, 1998). Thus, long-term health messages and children sharing enjoyable experiences within physical education programmes are important components of health related activity. Therefore, the school is seen as a "vital place in which to establish and develop behavioural patterns appropriate for health and well-being, including physical activity" (Smith and Biddle, 1995: 99) and

[18] Pease, D. G. and Andersen, D. F. (1986) Longitudinal analysis of children's attitudes toward sport team involvement. *Journal of Sport Behaviour*, 9: 3-10. Cited in Doganis and Theodorakis (1995)
[19] McIntosh, D. K. and Albinson, A. (1982) Physical education in Ontario secondary schools: a follow-up study. *Canadian Association for Health Education and Recreation Journal*, 48: 14-17. Cited in Doganis and Theodorakis (1995)

physical education has featured heavily in health promotion (Smith and Biddle, 1995).

It has previously been s uggested that in physical education, pupils should always be c hallenged if they display negative attitudes towards the subject (Rose, 1997). This acts as an attempt to somehow redress an instinctive love of physical activity that children are born with which is gradually eroded because of unpleasant experiences (Sleap and Warburton, 1996). Thus, it is the task of physical education not to turn children off PE but to make it valued and enjoyed. M acfadyen (2000) highlights that even though PE is a worthwhile and enjoyable experience for many pupils, physical education lessons can become an unpleasant ordeal for many others and therefore have implications for later attitudes toward physical activity.

An experimental study found that an i ncreased and specialised PE programme during primary schooling did not encourage participants to adopt a more physically active lifestyle during adulthood than those who received standard PE teaching (Trudeau et al., 1999). The experimental subjects who received a more positive and enthusiastic experience of physical education did not hold a more positive attitude towards physical activity as adults. The findings of this study therefore indicate that a specialised PE programme has no effect upon attitudes towards physical activity. Sleap of Warburton (1992) suggest that daily exercise sessions/physical education lessons are problematic due to the danger that children could perceive physical activity as an unpleasant duty and a chore, thus developing negative attitudes and reducing possible adult participation in physical activity and sport. Therefore, some children already perceive physical activity as an unpleasant duty due to their experience of PE.

Persistent negative feelings towards PE can result in a pupil feeling alienated. Work by Carlson (1995) discusses the three affective states associated with alienation (meaninglessness, powerlessness and isolation) and has provided their application to physical education. For example, some students do not see a purpose for PE in their life (meaninglessness), others do not feel that they have control over what happens during PE lessons (powerlessness) and finally some students feel either socially or emotionally isolated from their peers in a PE class (isolation). As a result of in depth interviews with both pupils and staff at two schools an alienation-nonalienation model was developed to encompass the main components that contribute to alienation from PE (including intrinsic and extrinsic factors) and to show some of the interrelations between them (Carlson, 1995). As a result, it was advocated that a physical education approach which "includes all and alienates none" be developed (Carlson, 1995:475). However, it must be acknowledged that this would not be easy achieved due to the diverse needs and interests of young Britons but also the financial and time constraints in the preparation of prospective PE teachers (Fox and Harris, 2003).

Studies conducted among members of the adolescent population into attitudes and beliefs about various components of physical education have made a variety of findings. Milosevic (1996) found eleven to sixteen year olds to hold certain beliefs about PE activities. Participants deemed certain activity areas to be specifically for males or females whilst other activities were considered to be suitable for both genders. Despite these gender stereotypical views on sporting activities, more than half the respondents participated in sporting activities extra-curricularly but both boys and girls stated that boys have considerably more opportunities to take part in extra curricular sporting activities than girls. Milosevic (1996) therefore identified a need for broader unisex activities in physical education throughout the eleven to sixteen age range to arrest the decline in attitudes towards the subject. A study conducted by Macfayden (2000) found that the 14–15 year olds involved in a further study identified various physical education teachers (both past and present) as the most influential figures in the formation of their attitudes toward physical activity. Thus, certain PE teachers and teaching styles would foster positive attitudes towards future physical activity participation whilst the actions of other teachers would discourage future participation.

Quite often a student's dislike of physical education stems from contextual factors and not from the physical activity itself (Williams and Bedward, 1999). Issues such as PE kit/uniform and showering policies have an effect upon attitude towards the subject. Students find it unacceptable that they are expected to play outdoor games during the winter months wearing limited sports clothing. Similarly, students at schools that enforce strict showering policies considered the notion that showers are needed for hygiene reasons as a waste of time because you don't get a proper shower (Williams and

Bedward, 1999). However, research conducted in Canada found that curriculum content and PE teacher behaviour are considered the most important determinants of attitudes towards PE (Luke and Sinclair, 1991). Furthermore, students identified that the PE teacher is highly influential in determining negative attitudes towards the subject and therefore teachers should change their behaviour to foster more positive attitudes in their students (Luke and Sinclair, 1991).

1.6.2.1 Attitude and gender

Research indicates that boys hold a more positive attitude towards physical education and that their participation in both curricular and extra-curricular activity is looked upon as being compatible with prevailing notions of masculinity (Hopwood and Carrington, 1994). Sabo (1985)[20] states that competitiveness has been considered a masculine personality trait and that males have been socialised for competition much more than females. Subsequently, Anderssen and Wold (1992) were not surprised to find more frequent leisure time physical activity amongst Norwegian boys than girls. Research conducted in Turkey using the Attitudes Towards Physical Education Scales (devised by Demirhan and Altay, 1999) found that, irrespective of whether they participated in sport (i.e. either school athletic clubs or amateur sports clubs outside school), boys hold a significantly more favourable attitude towards PE than their female counterparts (Koca and Demirhan, 2004). Anderson and Wold (1992) also discovered that boys received more support for being physically active but when girls do receive

[20] Sabo, D. (1985) Sport, patriarchy and male identity: new questions about men and sport. *Arena Review*, 9(2): 1-30. Cited in Hopwood and Carrington (1994)

support they can be more responsive than boys. These findings were again explained in line with previously hypotheses; that sports participation for girls is not a societal expectation to the same degree as it is for boys (Hasbrook, 1986)[21].

Research conducted by Hopwood and Carrington (1994) using an attitude towards physical activity questionnaire found that boys and girls responses do generally comply with the notions of masculinity and femininity. Twice as many girls as boys said that they preferred not to compete against others; more boys than girls wanted to be remembered as a sports star at school whereas girls were more likely to prefer to be remembered as a brilliant student or as most popular; boys were more likely than girls to indicate that they would use an extra hour in school to do sports; and boys were more likely than girls to perceive themselves as having higher physical competence. As girls do not exert as much effort into physical education as boys due to a lower perceived competence, it has been suggested that efforts from home and other significant adults such as teachers or coaches can influence a child's perceived competence (Williams and Gill, 1995). Although it has been suggested that increasing the physical activity levels of girls has the potential to improve and enhance their sense of competence in PE (Armstrong and McManus, 1994), the work of Hopwood and Carrington (1994) would suggest that girls are not keen to increase their participation in structured physical activity.

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[21] Hasbrook, C.A. (1986) The sport participation-social class relationship: some recent youth sport participation data. *Sociology of Sport Journal*, 3: 154-159. Cited in Anderssen and Wold (1992)

Fifteen and sixteen year old girls are twice as likely as boys to excuse themselves from PE (Milosevic, 1996) and this dislike of physical activity looks as though it would continue after compulsory education. Interviews conducted by Williams and Bedward (1999) found a significant number of adolescent girls expressed a dislike of winter games whilst others considered team games to be the highlight of their PE timetable. Similarly, in a qualitative study, interviews conducted among young women attending secondary schools showed that there was a general dislike of the subject and that many girls would attempt different strategies to avoid taking part, including the use of the same sick note for several weeks (Mulvihill, Rivers and Aggleton, 2000). Furthermore, Milosevic (1996) found that only 14% of girls were highly likely to continue with activities after leaving school compared with 42% of boys. Shropshire et al. (1997) recognise that adolescent girls are the group which is most at risk of losing interest thus engaging in less physical activity. They continue to make the recommendation that ways need to be found to arrest the fall in girls' enthusiasm for physical education from an early age.

Physical education in itself can develop a feeling of alienation for many girls, as few girls conform to the physique they believe society values (Armstrong and McManus, 1994). As female pubertal development is accompanied by significant weight gain and fat deposits around the hips, thighs, buttocks and waist (Levine and Smolak, 2002) some adolescent girls are particularly sensitive to body-shape changes in terms of their perceived body image (Sharp, 1995). Levine and Smolak (2002: 75) suggest that as girls move through the stages of puberty in early adolescence there is an association between 'increased body mass, a more negative body image, and higher levels of drive for thinness and dieting'. Physical-self perception has been found to influence physical persistence, arousal and level of involvement in physical activity (Gilson, Cooke and Mahoney, 1999). Therefore, it can be suggested that these factors influence young adolescent girls' attitudes towards physical education and teachers and health practitioners need to develop PE programmes which consider the needs of adolescent girl's.

1.6.2.2 Attitude and ethnicity

It was one of the Sports Council's (1994) objectives that black and other ethnic minorities should develop positive attitudes toward an active lifestyle. However, according to Rai and Finch (1997), attitudes and beliefs act as barriers and prevent black and South Asian people from participating in physical activity. Some explanations provided for low participation levels found as a result of the study conducted by Rai and Finch (1997) are listed below:

- lack of motivation (no will power, no one to go with, not enjoyable, don't feel like it, TV, cold weather);
- at different life stages (lose touch with the crowd, priorities change, growing old);
- lack of importance (fitness is not an issue, looking good is not important, past efforts have been ineffective).

In conclusion, it was found that exercise was of low priority to black and South Asian men and women and they chose to use their limited spare time in other ways (Rai and Finch, 1997).

It is reasonable to assume that cultural differences affect attitudes towards physical education, sport and other leisure activities (Figueroa, 1993) but a negative childhood experience of physical education experienced by members of ethnic minorities can also alter the priority given to physical activity. Both Muslim and non-Muslim adolescent female students interviewed by Williams and Bedward (1999) felt it was unfair that the school policy allowed Muslim girls to wear tracksuits when the remainder of the girls could only wear a t-shirt and games skirt as it was perceived that it made Muslims stand out from other pupils. The adolescent girls questioned in the study also found it to be wholly unacceptable to expect them to play outdoor winter games in adverse weather conditions. Similarly, Carroll and Hollinshead (1993) found that Muslim girls at a comprehensive school in the North of England felt that physical education dress was unsuitable, as was the communal shower policy. This unsuitability linked again with the need for modesty. However, Siraj-Blatchford (1993) criticised the case study and suggested that it was no wonder the children were caught in a conflict between their community values and those of the school and that it is the responsibility of the school to promote equality and work together with parents and the community.

Research conducted amongst the adult black and South Asian communities in England found that people from these minorities identified a combination of barriers to participation and many Asian respondents mentioned that family obligations were more important than personal preferences (Rai and Finch, 1997). The strength of family commitments with regard to members of the Asian community also extends to children who experience conflict between home life and extra-curricular sporting activities (Carroll and Hollinshead, 1993).

1.7 Justification for the present study

Although studied with less frequency than amongst adult populations, the health related benefits of a physically active lifestyle in youth have been well documented in the literature and multiple beneficial health outcomes in young people for both current and future health have been identified (Bar-Or and Rowland, 2004; Fox, 2003; HEA, 1998; Sallis and Patrick, 1994). However, it has been suggested that the relationship between physical activity and health in youth is less clear than for adult populations (Guerra et al., 2006, Twisk, 2001, Riddoch and Boreham, 2000).

Research indicates that irrespective of age and method of data collection, boys engage in significantly more physical activity than girls (Cox et al., 2006; Santos et al., 2003; Shropshire and Carroll, 1998; Armstrong and McManus, 1994). In the U.K. people from certain ethnic minority groups have also been found to be less active than the general population (Fischbacher et al., 2004). Although the evidence base is less extensive for young people, research has found that among youth, prevalence of physical activity is lower among those from ethnic minority groups (McGuire et al., 2002; Andersen et al., 1998; Sallis et al., 1998). Therefore, it has been advocated that further research be conducted into the physical activity habits of priority groups including ethnic minority groups, adolescents, and young females (HEA, 1998). The decline in childhood physical activity with age is also of great significance. When compared with adults, adolescents are quite physically active (Pate et al., 1994) and research suggests that during late childhood and early adolescence physical activity is a moderately stable variable (Janz et al., 2002; Pate et al., 1999). However, the older young people become the more their physical activity falls (Pate et al, 1999; Harris, 1998) and a steep downward trend during adolescence has been identified (Biddle et al., 2004; Pate et al., 1994) although additional research suggests that a significant fall in activity levels can occur earlier in childhood (Trost et al., 2002; Vincent and Pangrazi, 2002). Table 1 summarises the findings of previous physical activity research concerned with ethnicity, gender and school year. However, research has been largely cross-sectional and longitudinal designs are limited. Therefore, studies tracking the physical activity levels of young people would help to further identify the trend in falling activity levels and data used for intervention targeting.

It has previously been suggested that adult physical activity guidelines for the maintenance of health are inappropriate for young people as such recommendations would show children to be inactive (Pangrazi et al., 1997) due to the fact that young people's physical activity is intermittent (HEA, 1998; Pangrazi et al., 1997; Sleap and Warburton, 1994). Subsequently, physical

Table 1. Summary of previously published physical activity research concerned with ethnicity, gender and school year.

Study	Participants	Physical activity measure	Ethnicity	Gender	School year/age	Outcomes
Andersen et al. (1998)	U.S.; 8-16 years	Interview	X	X	X	Vigorous activity among ethnic minority children is lower than in non-Hispanic white children. Boys were more active and watched more TV than girls. Girls' activity falls between 11-13 years and 14-16 years.
Armstrong and McManus (1994)	England; 11-16 years	Heart rate monitoring		X		Boys spent a higher percentage of their time with heart rates above 70 to 80% of their maximal heart rate.
Cale (1996)	England; 10-12 years	Self-report questionnaire		X		Boys expended more energy and spent more time in MVPA than girls
Carroll and Shropshire (1999)	England; 10-12 years	Self-report questionnaire			X	Activity levels increased between the last year of primary school (10-11 years) and the first year of secondary school (11-12 years).
Cox et al. (2006)	New Zealand; 5-11 years	Pedometry		X		Boys completed more steps than girls (15,606 steps/day for boys and 13,031 steps/day for girls).
Duncan et al. (2007)	England; 8-11 years	Pedometry		X		Boys completed more steps than girls (12,263 steps/day for boys and 11,748 steps/day for girls).
Eisenmann, Bartee and Wang (2002)	U.S.; 14-18 years	Self-report questionnaire	X	X	X	White boys and girls engaged in more MVPA than African American and Hispanic boys and girls. Boys and girls from ethnic minority groups watched more TV. Boys engaged in more MVPA than girls. MPA remained stable but time spent in VPA decreased with age.

Continued next page

Eisenmann, Katzmarzyk and Tremblay (2004)	Canada; 12-19 years	Self-report questionnaire		X	X	Boys expended more energy than girls. 12-14 year olds expended more energy than 15-19 year olds.
Gordon-Larsen, Adair and Popkin (2002)	U.S.; 12-22 years	Self-report questionnaire	X	X		Non-Hispanic blacks were more inactive than other ethnic groups. Boys engaged in more MVPA than girls (MVPA highest for Asian and non-Hispanic white boys and lowest for Hispanic and non-Hispanic black girls).
Hovell et al. (1999)	U.S.; 8-11 years	Recall questionnaire		X	X	Boys took part in more moderate intensity activity than girls but energy expenditure was similar. Energy expenditure decreased from the fourth grade (9-10 years) to the sixth grade (11-12 years).
McGuire et al. (2002)	U.S.; 11-15 years	Self-report questionnaire	X	X	X	Whites were more active and blacks watched more television than all other ethnic groups. Boys spent more time in activity than girls but also watched more TV. No difference was found between older and younger participants.
McVeigh et al. (2004)	South Africa; 9 years	Retrospective interview	X			White children were more active, more likely to participate in PE and watch less TV than black children.
Mechelen and Kemper (1995)	Netherlands; 12-27 years	Semi-structured interview			X	Time spent in physical activity decreased between 13-16 years (3% decrease for females and 20% decrease for males).
Patrick et al. (2004)	U.S.; 11-15 years	Accelerometry		X		Boys were more inactive than girls (girls watched more TV than boys; majority of boys and minority of girls met 60 min/day physical activity recommendations).

Continued next page

Santos et al. (2003)	Portugal; 8-15 years	Accelerometry		X	X	Boys engage in more periods of continuous MVPA than girls particularly between 11-13 years. Time spent in MVPA increased between 11-13 years and 14-16 years.
Sallis et al. (1998)	U.S.; 11-12 years	Accelerometry and retrospective interviews	X	X		Whites expended more energy than Mexican Americans but there were no ethnic differences in accelerometer scores. Boys were more active than girls on both measures.
Shropshire and Carroll (1998)	England ; 10-11 years	Self-report questionnaire		X		Boys on average 1.5 hours per week more active than girls and participate at higher intensities.
Simons-Morton et al. (1990)	U.S.; 7-9 years	Self-report techniques		X	X	Third grade reported more total LMVPA (MVPA >10min duration) than fourth grade. Third grade boys reported more total LMVPA than girls while fourth grade boys reported fewer LMVPA than girls.
Trost et al. (2002)	U.S.; 6-18 years	Accelerometry		X	X	Boys engaged in more MVPA than girls MVPA declined with age (most sharply between school grades 1-3 and grades 4-6).
Vincent and Pangrazi (2002)	U.S.; 6-12 years	Pedometry		X	X	Boys completed more steps than girls (13,162 steps/day for boys and 10,923 steps/day for girls). No difference according to age.

activity recommendations for young people have been devised both internationally (Sallis and Patrick, 1994) and for the U.K. youth population (HEA, 1998). In addition, it has previously been suggested that children are the fittest section of the population (Armstrong and McManus, 1994). However, the prevalence of obesity in young people has increased over recent years to a degree that poses significant risk to health (Stamatakis et al., 2006; Davison and Birch, 2001; HEA, 1998; WHO, 1997). Therefore, further research is required to monitor these trends with particular reference to advocated physical activity guidelines.

Why certain individuals participate in greater amounts of physical activity is unclear but a link between attitude and behaviour has previously been established (Biddle and Mutrie, 2007). The theories of reasoned action (TRA) and planned behaviour (TPB) have been used to predict behaviour. Future participation in a physically active lifestyle stems from the fostering of a positive attitude towards physical education (Silverman and Subramaniam, 1999; Carlson, 1995; Portman, 1995; Ennis, 1996) as it is an assumption that the primary goal of physical education is to promote lifelong physical activity (Corbin, 2002). Therefore, further research into the attitudes of young people towards physical education can inform health workers and educationalists alike in setting target interventions and the writing of curricula.

This study aims to contribute to the area of knowledge concerning young people's physical activity levels with particular reference to ethnicity, gender and school year. In addition to this, age related changes in physical activity within these groups will be observed through a short-longitudinal research design. Attitude towards the subject of physical education and its relationship with physical activity will be studied. Finally, components of health related fitness will be measured and any association between this and physical activity will be established.

1.7.1 Hypotheses

As a result of the review of relevant literature, the following research hypotheses will be examined:

H1 There is a significant difference in young people's physical activity according to ethnicity.

H2 There is a significant difference in young people's physical activity according to gender.

H3 There is a significant difference in young people's physical activity according to school year.

H4 There is a significant difference in young people's physical activity over time.

H5 There is a significant difference in young people's attitudes towards physical education according to ethnicity.

H6 There is a significant difference in young people's attitudes towards physical education according to gender.

H7 There is a significant difference in young people's attitudes towards physical education according to school year.

H8 There is a significant difference in young people's health related fitness according to ethnicity.

H9 There is a significant difference in young people's health related fitness according to gender.

H10 There is a significant difference in young people's health related fitness according to school year.

H11 There is a significant difference in young people's health related fitness over time.

H12 There is a significant relationship between young people's physical activity and attitude towards physical education.

H13 There is a significant relationship between young people's physical activity and health related fitness.

2.0 REVIEW AND CRITIQUE OF AVAILABLE METHODOLOGIES

2.1 Measurement of physical activity

In recent times there has been greater awareness of the importance of physical activity in health and therefore physical activity is a more pertinent variable than fitness to assess regarding health (Rowlands et al., 1997). Physical activity is most often described in terms of energy expenditure, watts (rate of work performed), counts (units of movement) or as a numerical score (Montoye, Kemper, Saris and Washburn, 1996). However, physical activity can also be defined in terms of an intentional behaviour (Rowlands et al., 1997; Montoye et al., 1996). It is therefore of benefit to assess other dimensions of physical activity; such as the circumstances and purpose of the activity, for example, whether activity is being participated in voluntarily or through necessity.

According to Weston, Petrosa and Pate (1997), valid measures of physical activity are needed in the conduct of studies designed to develop effective programmes for physical activity promotion. However, because there are errors in all measures of physical activity, it is impossible to determine their validity when intercorrelating various field measures (Montoye et al., 1996). Rowlands, Eston and Ingledew (1997) state that the measurement of physical activity in large scale research requires a method that is low in cost, agreeable to the study volunteer and accurate. In addition, Armstrong and Welsman (1997) suggest that not only should the intensity, frequency and duration of activities be monitored, they should ideally be monitored over a minimum period of three days. Ultimately, techniques used must be socially acceptable and should minimally influence the subjects' normal activity patterns (Armstrong and Welsman, 1997).

Given that national policies are based on prevalence estimates of meeting physical activity guidelines, it is essential that prevalence estimates are accurate (Sarkin, Nichols, Sallis and Calfas, 2000). However, results show that the prevalence of meeting physical activity guidelines is dependent on the physical activity measure and the scoring protocol used (Sarkin et al., 2000).

2.1.1 Measurement of young people's physical activity

Due to the fact that the precise quantification of physical activity is necessary in order to evaluate the relationship between physical activity and various types of disease and/or disease risk factors (Kowalski, Crocker and Kowalski, 1997; Freedson, 1989) a continual challenge is faced by researchers and practitioners with regard to assessing physical activity in children and adolescents.

There exists a range of over 30 methods for estimating adults' physical activity (Armstrong and Welsman, 1997) and many of these have been used to assess the habitual physical activity of young people. However, it is important to consider the nature of childhood activity as children's activity patterns are very different from those of adults (Louie, Eston, Rowlands, Tong, Ingledew and Fu, 1999). Citing the work of others, Louie et al. (1999) suggest that children's activity is not rhythmic and prolonged but is instead highly transitory. Therefore, methods have been used amongst the paediatric population without appropriate consideration being taken of factors that can limit their feasibility and validity.

2.2 Measures of physical activity

Assessment of physical activity can be measured either subjectively or objectively using both laboratory and field settings. However, all methods of physical activity assessment have advantages and limitations (Montoye et al., 1996) and a wide range of different methods have been used to quantify physical activity levels in children and adolescents.

It has been proposed that when assessing children's physical activity habits objective monitoring is necessary due to children's inability to recall activities and/or answer questions about the activity (Trost, 2001; Freedson, 1989). Furthermore, Sallis (1993) believes that valid, practical, and affordable objective measures of physical activity are necessary for improved epidemiological studies. However, it is acknowledged that the use of objective devices (such as heart rate monitors, pedometers and accelerometers) with children in field-based settings poses additional methodological problems (Trost, 2001) and therefore more subjective methods (e.g. self-report questionnaires, observation) are more appropriate, what is more, objective methods "do little to inform on how, where, and why" physical activity behaviours are undertaken (McKenna, Foster and Page, 2004: 5).

It is largely accepted that the method of using doubly labelled water (DLW) is the gold standard for assessing energy expenditure (Montoye et al., 1996). However, this technique's expense makes it impractical for use in epidemiological studies although the principle behind the method is relatively simple. Subjects are required to consume a dose of isotope-enriched water and to provide urine samples after seven and fourteen days (two-point method) or daily (multipoint method). The fluid contains a known concentration of isotopes of both hydrogen and oxygen which is higher than what which occurs naturally. From the difference in the elimination of the two isotopes it is possible to calculate the quantity of carbon dioxide produced and therefore, using an estimation of the respiratory quotient (normally 0.85 in Western societies), to calculate oxygen uptake (Rowlands, 2001). However, a difference of 0.01 between estimated and actual respiratory quotient would result in an error of approximately 1% in calculated energy expenditure (Montoye et al., 1996). In addition, this method of assessing physical activity only obtains a measure of energy expenditure and does not provide information regarding activity patterns or exercise intensity (Rowlands, 2001). Although DLW is not widely used in the assessment of energy expednriture due to its high cost, it is the benchmark against which other methods of assessment are validated.

2.2.1 Self-report and proxy report measures

Self-report questionnaires are the most widely used method in epidemiological research (Sarkin et al., 2000; Armstrong and Welsman, 1997). This is largely due to ease and low-cost implementation (Matthews, 1999; Armstrong and

Welsman, 1997; Kowalski et. al, 1997; Montoye et al., 1996; Cale, 1994). Self-report methods include retrospective questionnaires, interview-administered recall, activity diaries and mail surveys. Cale (1994), states that self-report measures can be classified into three groups: concurrent or end-of-the-day diaries; retrospective reports on self-completed forms and retrospective interviewer-conducted forms.

Self-administered questionnaires are believed to be less accurate than questionnaires administered by an interviewer (Montoye and Taylor, 1984[22]). The ability to accurately recall and classify one's physical activity is a subjective evaluation that can be enhanced by an interviewer (Freedson, 1989). It has been suggested that children lack the cognitive ability to recall the details of their physical activity patterns (Rowlands et al., 1997) and that when compared with adults children are believed to "notice less, omit more, forget faster, be more susceptible to suggestion and to intermingle imagination and perception in remembering" (Cale, 1994: 140). Research indicates that children below the age of ten years are unable to provide gross estimates of physical activity (Sallis, 1993). The work of McKenna, Foster and Page (2004) found that even within a 24 hour period there was a tendency for young people to overestimate when recalling duration and frequency of activity. However, when questioned by the interviewer, the values reported by the participant were revised downward.

[22] Montoye, H.J. and Taylor, H.L. (1984) Measurement of physical activity in population studies: a review. Human Biology, 56:195-216. Cited in Armstrong and Welsman (1997:104)

It has been found that with age, children and adolescents become more consistent in their self-reports irrespective of the assessment method used (Kowalski et al., 1997). When considering the characteristics of self-report questionnaires, Sarkin et al. (2000) suggested that a number of factors can affect estimates of physical activity. These factors can be summarised as how physical activity is defined, how questions are worded, how response sets and scales are used, and, how raw data are summarised or scored.

Many adult activity questionnaires, or indeed questionnaires specifically designed for respondents of a certain age, have been modified for use with young people. For example, the Physical Activity Questionnaire for Adolescents (PAQ-A) is an adolescent version of the Physical Activity Questionnaire for Children (PAQ-C) (Kowalski, Crocker and Faulkner, 1997)[23]. The PAQ-A was validated by Kowalski et al. (1997) using various methods of physical activity assessment (questionnaires, interview and Caltrac motion sensors) and found that the PAQ-A was moderately correlated with other physical activity measures.

However, investigators have created questionnaires specifically designed for use with children (Ridley, Dollman and Olds, 2001; Trost, Ward, McGraw and Pate, 1999; Cale, 1994). After a thorough analysis of various self-report methods of physical activity, Cale (1994) identified a number of improvements to aid in the design of a new and alternative measure designed specifically for

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[23] Kowalski, K.C., Crocker, P.R.E., Faulkner, R.A. (1997) Validation of the Physical Activity Questionnaire for Older Children. Pediatric Exercise Science, 9: 174-186. Cited in Kowalski, Crocker and Kowalski (1997:343)

British children aged 11 years and upwards. To aid the recall of information, the four by one-day recall questionnaire (Cale, 1994) records the previous day's activity only and has two forms – a school day and a weekend form. Respondents record events sequentially in a report form which is segmented into parts of the day. The questionnaire also provides respondents with the opportunity to consider habitual or indeed unusual events which occurred the previous day. These design features enable children to provide more accurate information regarding intensity and duration of activity by putting activities into context and providing time-related cues (Cale, 1994). Furthermore, the questionnaire is designed to be interviewer administered which is said to facilitate recall by "gaining activity information which otherwise may be lost" (Cale, 1994: 447). Finally, analysis of the questionnaire can elicit: average daily energy expenditure ($kcal^{-1} \cdot kg^{-1} \cdot day$); time spent in moderate intensity activity; time spent in hard and very hard intensity activity; and the number of bouts of 'huff and puff' activity the child engages in. The four by one-day recall questionnaire represents the only known self-report measure of its kind which has been designed and evaluated in such a methodical way (Cale, 1994). The questionnaire was found to have test-retest reliability ($r=0.62$, $p<0.05$) and concurrent validity when compared with heart rate monitoring and an observational method ($r=0.61$, $p<0.01$ and $r=0.79$, $p<0.01$ for heart rate monitoring and observation respectively) (Cale, 1994).

As previously mentioned, research has indicated that children's self-report methods correlate with objective measures of physical activity (Kowalski et al., 1997; Cale, 1994). However, Sallis (1993) found that the gender difference in physical activity levels is greater when objective measures are used thus implying that there is a tendency for less active respondents (i.e. girls) to over-estimate physical activity levels. Other sources of error need to be considered when using self-report measures of physical activity and are more pertinent when considering conducting research with young people. For example, how activity varies from weekday to weekend, or from season to season and how many days of assessed activity are necessary to obtain a reliable estimate of habitual physical activity (Cale, 1994). Therefore, great care should be taken by the researcher with regard to the selection of self-report method and a number of factors should be considered (Cale, 1994). These include the age and developmental stage of the respondents, the type and detail of physical activity information required and the time available for both researcher and respondent to give to data collection.

Proxy reports can be completed by adults (such as parents or teachers) reporting the child's physical activity. According to Freedson (1989), if questionnaires are being used to assess the physical activity of 3-6 year old children then the questionnaire should be directed to the parent. Alternatively, other significant adults such as teachers can complete the questionnaires on the child's behalf. However, the selection of a significant adult to complete a proxy-report on a child's physical activity can result in a difference in the results obtained, for example Noland, Danner, McFadden, Dewalt and Kotchen (1990) found that parents consistently rated their children's physical activity to be higher than class teachers did. This difference could reflect the differences between children's physical activity at home and at school.

However, follow-up data collection using observation techniques did not support this finding (Noland et al., 1990). In addition, more recent research has indicated that neither parent nor teachers can recall the same level of detail as the young people themselves (when interviewed) and therefore, the value of proxy reports can be questioned (McKenna, Foster and Page, 2004).

With reference to the diary method of data collection, several advantages have been identified. Data collection requires little involvement by the investigator and can be collected by numerous subjects simultaneously (Montoye et al., 1996). However, Armstrong and Welsman (1997) conclude that although physical activity diaries have been reported to be superior to retrospective questionnaires, diaries place a heavy burden on subjects and can, in fact, influence physical activity levels. Due to the fact that co-operation and conscientiousness on the part of the subject is essential it is suggested that the diary method is not well suited to the child population. In addition, processing a large volume of data can be time consuming for the researcher (Montoye et al., 1996).

In summary, the major advantage of self- and proxy-report measures of physical activity is low cost which facilitates its easy implementation with large numbers of subjects when compared with other data collection methods. However, Weston, Petrosa and Pate (1997) suggest that these measures of physical activity are limited by lack of specificity and have not been fully examined for evidence of reliability and validity.

2.2.2 Observation

Direct observation is an important method for assessing physical activity and classifies observed physical activity into distinct categories which can then be quantified and analysed in greater depth (McKenzie, 2002). As well as possessing face validity, observation techniques allow the recording of additional information such as the social context in which activity occurs; when, where and with whom it occurs (McKenzie, 2002; Rowlands, 2001). The assessment of physical activity by means of observation has made recent technological advances (Armstrong and Welsman, 1997), allowing observational codes to be entered and analysed by computers live or from video tape (McKenzie, 1999). But the main advantage of observation technique is that children's physical activity levels can be observed reliably, and observers can be trained quickly to record accurate information. A review of observational recording techniques by Armstrong and Welsman (1997) has identified eight sophisticated methodologies but all were designed for younger children and none specifically designed for older children and adolescents.

Puhl, Greaves, Hoyt and Baronowski (1990) designed the Children's Activity Rating Scale (CARS) to categorise the intensity of physical activities and discriminate between levels of energy expenditure in young children. CARS is based on five categories of physical activity which reflect levels of energy expenditure and was found to be a field observation system that is practical, reliable, and discriminates between energy expenditure in children. But unfortunately, it is designed for observation of young children (three to four year olds). The accuracy of the CARS as an estimate of energy expenditure has been thrown into doubt due to the nature of young children's physical activity and the presence of only five categories in the scale (DuRant, Baronowski, Puhl, Rhodes, Davis, Greaves and Thompson, 1993). It has been suggested that the accuracy of the information elicited through the technique is dependent upon the frequency of the observations and that they should be frequent enough to capture the intermittency of children's physical activity patterns (Rowlands, 2001). Furthermore, McKenzie (2002) states that more activity categories and levels of categories do allow for greater precision during analysis but that as a result disadvantages are identified (e.g. more challenging and tedious for the observer). DuRant et. al. (1993) suggest that it is probably a better method of assessing events of aerobic activity than of assessing energy expenditure.

Unfortunately, observation studies are labour-intensive, time-consuming and costly (Armstrong and Welsman, 1997) and insufficient research exists to indicate which systems are most accurate and reliable. Similarly, more evidence is required to ascertain the extent to which well-trained observers affect subject behaviour. However, Puhl et. al. (1990) suggests that direct observation can be reactive but that over time most children ignore the observer's presence although is and it has been reported that reactive behaviour is more of a problem when observing adults as opposed to children (Rowlands, 2001). In conclusion, it has been stated that observation has several advantages over other field techniques (Puhl et al., 1990). Observation is not limited by recall ability or self-report biases as it provides information on the specific type of activity that occurs, furthermore, direct observation can occur in a variety of settings, for short or long periods of time, and does not require equipment that hinders movement.

2.2.3 Motion sensor monitoring

Motion sensors are available in two forms: accelerometers and pedometers. Pedometers are the most basic of the two devices simply recording a total number of movement counts whereas accelerometers can record and store data on the frequency, intensity and duration of movement. Both devises are relatively small in size and can be worn around the waist, subsequently, the monitors interfere little with subjects' daily lives (Nilsson, Ekelund, Yngve and Sjostrom, 2002). However, a concern for both these devices is the issues of reactivity. Although, research conducted by Ozdoba, Corbin and Le Masurier (2004) found that reactivity does not exist when using unsealed pedometers with 9-10 year North American school children, the researchers advocated that it is still prudent to seal pedometers to avoid the loss of data. Therefore, Ozdoba and colleagues found that although the children were able to gain feedback from the pedometer (i.e. to see the number of steps completed), the mean daily step count did not follow a downward trend over time as novelty wore off.

As has previously been reported young people's activity largely tends to comprise short intermittent bouts (e.g. HEA, 1998; Pangrazi et al., 1997; Sallo and Silla, 1997), therefore, pedometers provide an ideal tool for use with children as they record total accumulated activity (Ozdoba et al., 2004). Rowlands et al. (1997) conclude that with their objectivity, low cost and ease of use, pedometers are well suited to population studies and the assessment of physical activity in children.

Although there has been a recent resurgence in the used of pedometry as a measure physical activity, uniaxial accelerometers (Caltrac) have largely replaced movement counters due to the more detailed data collection they are it is capable of (Armstrong and Welsman, 1997). In recent years the TriTrac-R3D has been developed to correct some of Caltrac's limitations and is considered to be the most accurate activity monitor. The TriTrac is capable of distinguishing vertical inclination and sideways motion whereas the Caltrac only identifies forward horizontal movement.

The principle behind motion sensors assumes that when a person moves, the limbs and body are accelerated in proportion to the muscular forces required and therefore energy is expended (Montoye et al., 1996). Motion sensors can be programmed to predict energy expenditure using basal metabolic rate estimated from stature, body mass, gender and age, plus total caloric expenditure estimated from activity. Modern motion sensors are small and unobtrusive and can store movement patterns for several weeks (Freedson, 1999). Although, accelerometers have grown to be very useful tools it has been suggested that the time and expense of using them can be prohibitive with large participant numbers (Armstrong and Welsman, 1997). In addition, when used in studies involving small children, accelerometers can still prove to be bulky (Louie et. al., 1999).

With reference to issues regarding the validity of pedometers and uniaxial accelerometers, Ozdoba et al. (2004) reported that pedometers correlated more highly with scaled oxygen uptake than both uniaxial accelerometers and heart rate monitors. Furthermore, Bassett et al. (1997) found a highly significant correlation between observation and pedometer readings. However, research conducted by Rowe, Maher, Raedeke and Lore (2004) found a weak and non-statistically significant correlation between pedometer data and data collected using the Leisure Time Exercise Questionnaire (LTEQ) devised by Godin and Shepherd (1985). However, Rowe et al. (2004) recognised that the LTEQ, although previously used among child populations, was originally designed for use with adults and therefore the appropriateness of the questionnaire as a measure of children's physical activity is questioned.

Another issue with reference to the validity of accelerometers is their placement. As previously mentioned, both pedometers and accelerometers should be placed around the waist and at the hip region, however, the work of Nilsson et al. (2002) found a significant correlation between hip and lower back placement of the accelerometer on children. They concluded that for participant comfort, the hip region is still more appropriate and advocated that further research be conducted to enable interstudy comparisons.

2.2.4 Heart rate monitoring

Heart rate monitors, or computerised telemetry systems, are self-contained and have been developed to measure heart rate unobtrusively (Armstrong and Welsman, 1997). Heart rate monitors take the form of a transmitter containing electrodes that is attached to the chest, and a receiver worn as a watch on the wrist. However, Rowlands et al. (1997) maintain that it is unlikely heart rate monitoring will ever be appropriate for epidemiological studies as sample sizes have to remain small due its expense and labour intensive nature. The positive attributes of heart rate monitoring have been considered to be socially acceptable as they permit freedom of movement, are not immediately noticeable, and therefore should not influence the child's normal physical activity pattern (Armstrong and Welsman, 1997). However, an investigation into heart rate intensity during physical education lessons conducted by Strand and Reeder (1993) provided recommendations for the use of heart rate monitors with children. It was suggested that wristbands be worn around the watches to prevent participants from increasing their heart rate due to the reading on the watch and that the training zones on the watches be set to minimum and maximum levels thus eliminating an auditory signal and reducing the subject's awareness of their own heart rate.

Although electrocardiographic telemetry and heart rate monitoring devices are considered to be accurate, some researchers are of the opinion that they are unsuitable for use with children for a number of reasons (Treiber, Musante, Hartdagan, Davis, Levy and Strong, 1989). Previously, it was suggested that heart-rate monitors can be particularly problematic for young children due to them being cumbersome and obtrusive. However, Treiber et al. (1989) stated that as well as being practical, the heart rate monitor used in their study (Sport Tester PE 3000) accurately assessed heart rate across a number of settings with many types of physical exercise. It was also noted that the four to ten year olds involved readily tolerated the heart rate monitors. More recently, it was stated that heart-rate monitors are small (Cooper, 2003), therefore, as technology has improved, the transmitter chest strap and watch receiver are more compact than previously. Cooper (2003) also reported that monitors are robust, relatively inexpensive and function in a variety of environments where physical activity takes place (e.g. in water).

The use of heart rate measurement to estimate energy expenditure originates as a result of work by Bergen and Christensen (1950)[24] where under laboratory conditions, a linear relationship between heart rate and oxygen consumption (as an indicator of energy expenditure) was identified. However, the use of heart rate to define the intensity of activity amongst adolescents has been deemed inappropriate as an individual's fitness level can influence heart rate and oxygen requirement (Ekelund, Poortvliet, Yngve, Hurtig-Wennlov, Nilsson and Sjostrom, 2001). Therefore, generic equations have been developed to calculate energy expenditure from the relationship between heart rate and oxygen uptake. The work of Iannotti, Claytor, Horn and Chen (2004) advocated that to increase precision individual heart rate-oxygen consumption equations should be used due to individual variations in a child's response to exercise. Therefore, individual equations significantly improve the prediction of energy expenditure from heart rate (Iannotti et al., 2004). However, it should be recognised that establishing individual equations would be expensive and labour intensive for the researcher and demanding upon the participant.

[24] Bergen, G. and Christensen, E.H. (1950) Heart rate and body temperature as indices of metabolic rate during work. *Arbeitsphysiologie*, **14**, 255-260. Cited in Armstrong and Welsman (1997:109).

How heart rate traces should be interpreted to indicate activity levels for children is less clear due to the nature of children's physical activity patterns. According to Armstrong and Welsman (1997) many investigators simply report the total time or percentage of time heart rates are above certain thresholds during the period studied. However, Strand and Reeder (1993) used Polar Vantage XL heart rate monitors in a study into the cardiovascular fitness levels of children in physical education and revealed that all the participant children in their study raised their heart rates into their training zone but none for a sustained period of 15 minutes. It has been suggested that this technique of interpreting data can be more representative of adult physical activity patterns (i.e. sustained periods of activity with heart rate elevated) (Armstrong and Welsman, 1997).

It has previously been suggested that heart rate monitoring is the most commonly used objective method to assess children's physical activity due to their relative low cost and ability to record values over time (Louie et al., 1999). However, heart rate monitors do have their limitations. A limitation of this technique is that frequency counts do not present a profile of activity (Freedson, 1989). Due to the fact that heart rate is sensitive to emotional stress, another factor responsible for an increased heart rate, a heart rate trace may not necessarily indicate an increase in physical activity (Rowlands et al., 1997). Furthermore, there are additional limitations including the assumptions based upon the linear relationship between heart rate and oxygen uptake.

2.2.5 Combining methods of physical activity assessment

The review of available measures to assess physical activity recognises that the assessment of young people's habitual physical activity is complex and that every method discussed has deficiencies as well as strengths. To provide information on total energy expenditure and thus physical activity, a combination of different techniques should ideally be used (Treuth, 2002; Armstrong and Welsman, 1997). However, the limitations of objective methods have previously been acknowledged as they fail to provide behavioural and contextual information which facilitates the development of intervention strategies to promote physical activity (Telford, Salmon, Jolley and Crawford, 2004). The use of a multiple methods to improve accuracy, particularly field-based measures, is relatively new and innovative (Treuth, 2002) and, as a result, Telford et al. (2004) advocate that a combination of measures be used to assess children's physical activity (i.e. self-report, proxy-report and objective measures). Armstrong and Welsman (1997) proposed the simultaneous use of doubly labelled water (to measure energy expenditure), heart-rate monitoring (to assess intensity of the activity) and observation (to provide information on the frequency, duration and type of activity) to measure the physical activity of young people. However, an approach where multiple physical activity measures are used would be costly both in terms of time and financial expense. Such studies are limited due to the burden placed upon participants and high administration costs and are therefore conducted with fewer numbers of subjects. Furthermore, most of these studies have been designed to test the reliability and validity of two or more methods.

Due to the nature of epidemiological studies the methods used will be dictated largely by practical, logistic, and financial considerations (Armstrong and Welsman, 1997). It has been previously suggested that direct and labour intensive measures (e.g. doubly labelled water and observation) should be used simultaneously to assess physical activity levels in small sample sizes (Saris, 1985). Therefore, larger epidemiological studies would require inexpensive and easily administered methods (e.g. questionnaires and movement sensors) (Treuth, 2002) and following a review of previously published work, Saris (1985)[25] recommended that questionnaires or movement counters are most appropriate for use with over 100 participants, whereas heart-rate monitoring, observation and doubly-labelled water should be used for fewer numbers.

2.3 Measures of health-related fitness

The measurement of physical fitness in young people has been of interest to physical educators, exercise scientists, health agencies and private organisations for many years (Safrit, 1990). As highlighted by Lohman (1992), within the physical education profession there has been a shift away from performance related fitness to an emphasis on the importance of health and well-being of young people. As well as for research purposes, Boreham and van Praagh (2001) suggest that testing can be undertaken for a number of reasons which include performance enhancement, education and clinical

[25] Saris W.H.M. (1985) The assessment and evaluation of daily physical activity in children: a review. *Acta Paediatrica Scandinavia*, 318:37-48. Cited in Cale and Harris (2005: 66).

diagnosis. Methods for assessment can be equally as varied and measurement of young people can take place in both laboratory and field settings. Boreham and van Praagh (2001) discuss the test batteries used with children, the North American AAHPERD (1988) and European EUROFIT (1988), and highlight that although such batteries are limiting, they are useful particularly in an educational setting and where large numbers of individuals need to be tested. However, it is important to consider that these test batteries measure both health related fitness and performance related abilities.

As with physical activity assessment, the evaluation of children's physical fitness using field-based measures can be problematic and many researchers have expressed concerns over the reliability, validity and usefulness of field-based measures to assess physical fitness (Harris and Cale, 2006; Armstrong and Biddle, 1992). Primarily, concerns are raised due to the fact that the only true way to assess physical fitness is in a laboratory as field tests are dependent upon an individual's motivation (Boreham and van Praagh, 2001). However, it is important to consider that although laboratory based measures are considered more valid, they can be impractical and costly (Harris and Cale, 2006). In addition, laboratory settings can lack ecological validity particularly for children as the environment in which measurements take place is unfamiliar and in some instances clinical.

A number of fitness tests have been developed to assess the components of health related fitness which are cardiovascular endurance, muscular endurance, muscular strength, flexibility and body composition (Marshall, Sarkin, Sallis and McKenzie, 1998). Certain protocols for fitness assessment are adapted from adult protocols and in these situations it is important that safety is a priority and that approval for testing children is sought first from appropriate authorities (Boreham and van Praagh, 2001). It has also been suggested that the extremes of performance be underplayed when carrying out fitness tests amongst the child population (Boreham and van Praagh, 2001).

During adolescence, chronological age is a poor indicator of biological age as rates of childhood growth and maturation can vary greatly and performance in field tests can be affected depending upon physical, emotional and intellectual development (Boreham and van Praagh, 2001; Bird and Davison, 1997). At various stages of growth and maturation it is important to consider that a child in any academic year group may be eleven months older than another which can exacerbate differences in biological age. Similarly, it is important to have an awareness of the various differences in anatomical and morphological growth between girls and boys (Boreham and van Praagh, 2001). Research has found that girls enter their adolescent growth spurt on average a full two years before their male counterparts (8.5-10.3 and 10.3-12.1 years respectively) (Malina, Bouchard and Beunen, 1988)[26]. Furthermore, during puberty differences in body composition and body shape between boys and girls will also become evident.

[26] Malina, R.M., Bouchard, C. and Beunen, G. (1988) Human Growth: selected aspects of current research on well-nourished children. Annual Review of Anthropology, 17:187-219. Cited in Armstrong and Welsman (1997:8).

2.3.1 Measures of body composition

Obesity is recognised as a serious health problem in the western world, one that reduces life expectancy by increasing a person's risk of developing coronary heart disease, hypertension, Type II diabetes and osteoarthritis amongst others debilitating conditions (Bouchard, 2000). However, too little body fat also poses a health risk because the body requires a certain amount of body fat to maintain normal physiological functions (e.g. the menstrual cycle) (Heyward and Stolarczyk, 1996). Additionally, lipids are required for growth and maturation during adolescence. Therefore, the assessment of body composition amongst the child population is essential to monitor the health of the next generation.

There are a number of methods used to assess body composition and body fat percentage, some suitable for use in the field and others requiring a laboratory setting. However, it has previously been recognised that sophisticated laboratory reference methods have "inherent practical limitations" (Fields, Goran and McCrory, 2002: 453).

Underwater/hydrostatic weighing or hydrodensitometry is recognised as the gold standard for body composition assessment (ACSM, 2000). This method is based on the relationship between density, mass and volume and Archimedes principle of water displacement. However, Hawes and Martin (2001) suggest that it is important to recognise the limitations of this method as they have largely been neglected over time. It has been claimed that hydrodensitometry has many flaws and is not a practical technique for many people as it requires a considerable amount of co-operation from subjects (Wagner and Heyward, 1999). The process of maximal exhalation and sitting still under water in a large tank of water would be particularly problematic for children and impossible for the very young (Goran, 1998) and subsequently, issues regarding validity are raised. Amongst adults, the densities of fat mass and fat-free mass are reported to be 0.9g/ml and 1.1g/ml respectively (Goran, 1998). However, it is acknowledged that different population groups have differing fat mass densities (i.e. age, gender and ethnic differences) (Lohman, 1992). With reference to children, very little research has been conducted into the specific body densities of children and further research is advocated before hydrodensitometry can be widely used with children. In addition, expensive equipment and specialist qualifications are required for this method which makes hydrodensitrometry impractical for large scale studies.

Dual-energy x-ray absorpitometry (DEXA) also requires expensive specialist equipment in a laboratory setting which rules it out of use in field studies. DEXA is a relatively new and attractive alternative to hydrodensitometry that yields estimates of bone mineral, fat, and lean soft tissue mass by means of low radiation x-ray beam (Heyward and Stolarczyk, 1996). Benefits of this method over hydrodensitometry include the need for minimal subject co-operation and most importantly DEXA accounts for individual differences in bone mineral density.

Air-displacement plethysmography has been termed a modern alternative to hydrostatic weighing and DEXA (Fields et al., 2002). It is again based upon the principles of displacement, as hydrodensitometry, but with reference to air displacement. Body volume is indirectly calculated by subtracting the volume of air inside the body when the subject is inside from the amount of air when the chamber is empty. However, isothermal air (i.e. air in the lungs or air trapped in the hair and clothing) can affect the accuracy of the measure (Fields et al., 2002). Furthermore, only one system is available for the measurement of air-displacement plethysmography; the BOD POD (Life Measurement Inc., Concord, California, US) and equipment is costly. More favourably, when compared with alternative methods this measure is relatively non-invasive, less time consuming and facilitates the measurement of various subject types (e.g. the young, elderly, obese and disabled) (Fields et al., 2002; Goran, 1998).

Compared with alternative measures, bioelectrical impedance analysis (BIA) does not require as much training to become a skilled technician (Heyward and Stolarczyk, 1996) and is thus very attractive for use in the field. The body's resistance to a low voltage electrical current is the theoretical basis behind this method. BIA requires the subject to adhere to strict guidelines to gain valid estimates of body composition making this method unfavourable for use with young people. However, in a review of research carried out using BIA with children, Goran (1998) questioned the precision of the measure due to the variability in children's hydration. Near-infrared interactance (NIR) is a relatively new method of body composition analysis that is also suitable for use in the field. This method is both rapid and safe but unfortunately there is much scepticism surrounding the use of NIR to assess body composition.

This is primarily due to the limited research has been conducted using human subjects and that an estimate of body fatness is made from the measurement of one site on the body. Therefore, at present skinfold measurement and BIA are preferred over NIR as field measures of body composition because they have been validated and refined through years of research (Heyward and Stolarczyk, 1996).

A widely used estimate of body composition is Body Mass Index (BMI). BMI has been popularised as a ratio that estimates body composition on the basis of various epidemiological studies that indicate a moderate correlation with estimates of body fat (Hawes and Martin, 2001). BMI expresses a three-dimensional measure (mass) in relation to a one-dimensional (linear) measure. It has been stated that BMI is a "surrogate measure of adiposity" because it is a measure of excess weight as opposed to excess body fat (relative to height) (Freedman, Wang, Maynard, Thornton, Mei, Peirson, Dietz and Horlick, 2005: 1). However, BMI does not take into account body shape and physique. Therefore, people who are heavy for their height can be heavy because they possess large muscle mass while others are heavy because they carry "excess adipose tissue" (Hawes and Martin, 2001: 20). For example, during adolescence an increased BMI in males can reflect muscular development rather than a greater proportion of body fat (Lohman, Boileau and Slaughter, 1984).

It is important to note that age, gender and world region specific cut-offs for BMI exist. Indeed, Flodmark, Lissau, Moreno, Pietrobelli and Widhalm (2004) highlighted that, age and gender specific BMI for overweight and obesity differ between the U.S. and Europe as they are based upon percentiles. The international cut-offs for overweight and obesity established by Cole, Bellizi, Flegal and Dietz (2000) were based upon the growth curves of young people from six countries (Great Britain, United States, The Netherlands, Brazil, Hong Kong and Singapore) and equated to BMI values of 25 kg/m^2 and 30 kg/m^2 at 18 years of age for overweight and obesity respectively. Furthermore, Deurenberg, Deurenberg-Yap and Guricci (2002) advocated that universal BMI cut-off points for people of different ethnicities should not be used as these cut-offs were established using predominantly white populations. From an overview of relevant literature, Deurenberg and colleagues (2002) reported that for the same body fat percent (as assessed using different methods), BMI values for Asians (comprising Chinese and Indians in addition to other Asian groups) were 3-4 points lower than for Caucasians.

With reference to youth populations, research conducted in the U.S. among 5-18 year olds has suggested that the accuracy of BMI as a surrogate measure of adiposity varies (i.e. BMI is strongly associated with fat mass among heavier children but only moderately associated among thinner children) (Freedman et al., 2005). Therefore, Freedman and colleagues concluded that BMI levels among children should be “interpreted with caution” (2005: 1). It has previously been reported that BMI in childhood changes markedly with age (Cole, Feeman and Preece, 1995). In recognition of this, Cole, Bellizzi, Flegal and Dietz (2000) deemed the widely used cut-off points for adults, inappropriate for use with children, and established international cut-off points for overweight and obesity in youth. Based upon six large, nationally representative, cross-sectional surveys from Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the U.S., Cole and colleagues developed age and gender specific cut-off points for young people (2-18 years). In addition, Cole et al. (2000: 1240) justify the use of BMI over measures of percent body fat as alternatives are “impracticable for epidemiological use”.

Body fat is often assessed using indirect measures (Flodmark et al., 2004), of which BMI is just one estimate, as the only direct method to assess body composition is on the dissection of cadavers. Both DEXA and hydodensitometry are indirect estimates based upon a number of assumptions. However, alternative field based methods, such as surface anthropometry and BMI, are doubly indirect due to the fact that they have been validated against methods such as densitometry. Nevertheless, it is surface anthropometry which is the most popular field based method for assessing body fatness. This technique involves the measurement of subcutaneous adipose tissue using skinfold thicknesses taken from different points on the body depending upon the anthropometric equation used. This method is easy to administer to large groups at a relatively low cost and requires little specialist equipment (Heyward and Stolarczyk, 1996). However, the accuracy of this method is largely dependent upon the skill of the technician. Those who are not properly trained can introduce a significant measurement error because a small difference in location can make significant differences in measurement (Harrison, Buskirk, Carter, Johnston, Lohman, Pollock, Roche and Wilmore, 1991). As there are in excess of 100 regression equations that have been derived for estimating percentage body fat from double folds of skin “it is important to select an equation that has been derived from a sample whose characteristics are similar to those of the subject to be measured” (Hawes and Martin, 2001: 18) which raises some caution about the efficacy of this conceptual framework. Due to differences in gender, age, ethnicicity, maturation and athletic status, the association between skinfold techniques and body fat can differ between population groups (Goran, 1998). However, surface anthropometry is non-invasive which makes this method particularly attractive for use among child populations (Boreham and van Praagh, 2001).

Due to the fact that the compressibility of skinfolds is increased in children because of greater hydration of tissue, adult body composition equations tend to overestimate the fat content of children (Lohman, 1992). The classic method for use with children requires the sum of measurements taken at four sites (biceps, triceps, subscapular and iliac crest) to be transformed into a percentage using an equation. However, according to Boreham and van Praagh (2001) this method is open to criticism due to the relatively small number of boys and girls measured. Alternatively, the sum of skinfolds has been found to correlate moderately highly with criterion measures such as hydrostatic weighing (Safrit, 1990). Thus, in recent years equations have been developed specifically for estimating body composition in children.

Prediction equations developed by Lohman (1992) were derived using only two skinfold measures (triceps and subscapular). However, these equations were derived from an earlier child-specific equation developed by triceps and medial calf/subscapular skinfold measurements (Slaughter et al., 1988)[27]. Janz et al. (1993) cross-validated the Slaughter skinfold (SKF) equations with hydrostatic weighing. Janz and colleagues (1993) found the sum of triceps and calf SKFs to over estimate the percent body fat of girls and that the prediction error for boys varied with maturation level. It was therefore advocated that to estimate percent body fat in boys and girls the sum of triceps and subscapular SKFs equation be utilised. However, for ethical and sensitivity considerations, it has been suggested that the use of the calf SKF as opposed to the subscapular SKF is particularly attractive in the measurement of young people because of the accessibility of the sites (i.e. children are not required to undress) (Heyward and Stolarczyk, 1996).

2.3.2 Measures of cardiovascular fitness

Due to the fact that more active individuals generally tend to possess greater aerobic power (Montoye et al., 1996) and the relationship between this factor and the risk of coronary heart disease (Boreham, Paliczka and Nichols, 1990), it is an essential factor in health related fitness assessment. Furthermore, the significance of measuring aerobic fitness in children due to its association with health have previously been identified (Raudsepp and Jürimäe, 1998).

Aerobic endurance can be directly measured in children in much the same way as the component is measured in adults, using a progressive incremental exercise test, during which oxygen uptake is ascertained (Boreham and van

[27] Slaughter, M.H., Lohman, T.G., Boileau, R.A et al. (1988) Skinfold equations for the estimation of body fatness in children and youth. *Human Biology*, 60: 709-723 Cited in Lohman, T. G. (1992)

Praagh, 2001). The direct measurement of oxygen uptake is recognised as the best physiological indicator of cardiovascular fitness in children (Armstrong and Welsman, 1997). However, a number of factors can account for performance in any test of cardiovascular fitness. According to Sjodin and Svedenhag (1985)[28] endurance performance is governed by three factors: aerobic power, aerobic capacity (sustained aerobic power), and movement economy.

Direct assessment procedures are unsuitable for large-scale field studies where simple tests requiring little equipment or expertise are essential (Boreham et al., 1990). Field measures can be particularly useful in an educational setting with large numbers of children or where time and equipment is limited (Boreham and van Praagh, 2001). Sallis (1993) is of the opinion that although field tests correlate well with VO_{2max}, they are not easily expressed relative to body mass. This brings into question the reliability and validity of such methods. However, indirect, and arguably field-based, methods of assessing cardiovascular fitness can possess greater ecological validity due to the fact that measurement is taking place in an environment familiar to the child as opposed to clinical/laboratory settings.

Field based tests, such as the twenty metre multistage fitness test (Brewer, Ramsbottom and Williams, 1988), the twelve minute run (Cooper, 1968) and the physical work capacity at a heart rate of 170 beats per minute (PWC_{170}) have shown variable but generally moderate correlations against laboratory

[28] Sjodin, B. and Svedenhag, J. (1985) Applied physiology of marathon running. *Sports Medicine*, 2: 83-99. Cited in Boreham and Van Praagh (2001:189).

measured VO_{2peak} (Boreham et al., 1990). The most widely used of these tests is the multistage fitness test which is based upon a positive linear relationship between maximal running speed (during completion of the incremental multistage fitness test) and oxygen consumption and therefore yields similar correlations with VO_{2peak} (Boreham et al., 1990). Research carried out by Boreham et al., (1990) amongst secondary school aged boys and girls revealed a validity of 0.87 when correlated with maximal oxygen uptake as determined by a treadmill protocol. Tucker and Tong (1995) with 11-13 year olds identified a test re-test reliability coefficient for the twenty metre multistage fitness test of 0.98. More recently, research conducted by Matsuzaka, Takahashi, Yamazoe, Kumakura, Ikeda, Wilk and Bar-Or (2004) amongst 132 Japanese children and adolescents (62 boys and 70 girls, aged 8-17 years) found significantly high correlations between predicted and measured VO_{2peak} (R^2 = .80). However, Matsuzaka and colleagues (2004) recognise that discrepancies in the prediction of VO_{2peak} have arisen due to the anthropometric characteristics of Japanese children and adolescents and their possible effect upon running economy.

The multistage fitness test is incremental, does not require a large area in which to be carried out and can be carried out indoors so long as the hall is at least twenty metres in length. The test also allows more than one child to be tested at any one time. Shuttle runs have also been incorporated into test batteries (such as FITNESSGRAM and Eurofit) to produce criterion-referenced norms for use particularly in educational settings. Literature therefore indicates that the twenty metre multistage fitness test is a reliable and valid tool for the assessment of cardiovascular fitness. Furthermore, it is practical to administer and a cost effective field based alternative to laboratory protocols.

2.3.3 Measures of muscular endurance

According to Gaul (1996) muscular endurance is the ability to use a muscle, or group of muscles to "generate force repeatedly or to sustain force production for an extended period of time" (p.253). As for muscular strength, isokinetic dynamometers can be used to assess muscular endurance (Gaul, 1996) and there are a number of protocols used in a procedure involving repetitive muscle actions through a full range of movement. Unfortunately, highly sophisticated and large equipment in clinical settings make this methodology unsuitable for use in the field.

In children, field tests of muscular endurance have normally involved the performance of sit-ups or pull ups and some tests employ static contractions for as long as possible (e.g. bent arm hang) or require the maximum number of repetitions within a set time (Rowland, 1990). Although there is no definitive test of abdominal strength and endurance, research has been carried out on the use of various versions of the sit-ups test (Safrit, 1990). According to Safrit (1990), literature indicates conclusively that the abdominal muscles are active during the performance of sit-ups. However, they are not the only muscles to be recruited in order to perform the movement, the hip flexors contribute to the sit-up action as well. Subsequently, concern has been expressed about the use of sit-ups as a measure of muscular endurance of the abdominal muscles (Sparling, Millard-Stafford and Snow, 1997). However, reliability estimates for sit-ups amongst young people have ranged from .62 to .93 for 11 to 14 year old boys and .64 to .94 for 11 to 14 year old girls (Safrit and Wood, 1987)[29].

Sit-ups have frequently been used as a measure of muscular strength and endurance and a test of abdominal muscular endurance is considered preferable because this area of the body is important in controlling excessive curvature of the lumbar spine (Docherty, 1996). What is more, sit-ups are considered to be especially useful in a school environment where time and specialist equipment is limited. Pull-ups are a field based alternative to sit-ups. However, as Docherty (1996) highlights, many people are incapable of completing one pull-up. This is partly due to the inverse relationship between body weight and number of pull-ups performed and thus weight should be taken into account (Safrit, 1990). Docherty (1996) concludes that this method is an invalid measure of muscular endurance because a child will still possess muscular endurance even though he or she cannot complete a single pull-up.

2.3.4 Measures of muscular strength

Strength itself is the ability of muscle to generate force (Boreham and van Praagh, 2001) or the maximal tension a muscle or group of muscles can exert against resitance (Gaul, 1996). In children, strength is gained at differing rates although it is generally accepted that strength increases with growth as muscle mass increases (Bar-Or and Rowland, 2004). Girls and boys possess

[29] Safrit, M.J. and Wood, T.M. (1997) The test battery reliability of the health related physical fitness test. Research Quarterly for Exercise and Sport, 58:160-167. Cited in Safrit (1990:21)

similar strength until the age of approximately 13-14 years when the boys enter into their growth spurt (Bar-Or and Rowland, 2004). It should be borne into mind that chronological age is a weak indicator of biological maturation as the point at which boys and girls enter puberty differs and therefore the point at which boys and girls acquire greater amounts of strength varies. As a result some girls are indeed stronger than boys of the same age. That said, it is acknowledged that the older adolescents become, the greater the strength gap between males and females. The health related benefits of muscular fitness are not as easily identifiable as those for aerobic endurance (Armstrong and Welsman, 1997) or indeed body composition, although it is clear that sufficient levels of muscular strength are required to carry out daily tasks. However, according to Bar-Or and Rowland (2004: 35) “strength is an important component of fitness in health and disease, because weak muscles can markedly limit a person’s physical fitness and daily physical abilities”.

Protocols used for the measurement of muscular strength in children are essentially the same as for adults with measurement taking place in both laboratory and field settings (Boreham and van Praagh, 2001). Muscular strength can be measured using one of three methods: isotonic strength measurement (maximal muscle action against resistance that remains constant throughout a range of movement), isometric measurement (muscle force generated while developing tension against an immovable resistance) or isokinetic measurement (strength measured through a complete range of movement while developing tension at a constant velocity). Amongst children, research has tended to focus on isometric and isokinetic measurement particularly with reference to field tests of muscular strength (Armstrong and Welsman, 1997).

Isotonic testing, as measured by stacked or free weights measuring one repetition maximum (1RM), is seldom carried out amongst youth groups for a number of reasons. Firstly, literature recommends children and adolescents should avoid the practice of lifting weights (American Academy of Pediatrics, 1990)[30] and that excessive loading and improper lifting techniques can result in fractures to the epiphyseal growth plates in bone. Secondly, the procedure of calculating 1RM is time consuming and requires a great deal of motivation from the participant. Thus, the appropriateness of this methodology in the measurement of young people's strength is questionable.

Isokinetic testing is carried out using expensive and sophisticated laboratory based isokinetic dynamometers requiring skilled and experienced practitioners to calibrate equipment and to interpret results. However, despite the high cost of such machines, data on young people's isokinetic contraction strength is accumulating (Armstrong and Welsman, 1997).

Portable isometric dynamometers are more commonly used to assess muscular strength in children and adolescents due to the fact that they are suitable for use in the field. Hand-grip dynamometry as a measure of muscular strength was used frequently prior to the development of isokinetic dynamometers (Gaul, 1996). Gaul (1996) also highlights that methodologies

[30] American Academy of Pediatrics (1990) Strength training, weight and power lifting, and body building in children and adolescents. Pediatrics, 86:801-803. Cited in Armstrong and Welsman (1997:148)

measure the grip strength of both left and right hands to allow for differences between dominant and non-dominant hands. However, the test uses isolated muscles, namely those in the forearm and hand (i.e. finger flexors), so the extent to which this test reflects overall body strength is questionable (Rowland, 1990). Moreover, hand-grip dynamometry can be affected by hand and arm positioning as well as the experience and motivation levels of the participant. It is essential that a standardised testing protocol be strictly adhered to to ensure that hand-grip dynamometry is accurately assessing isometric muscular strength.

2.3.5 Measures of flexibility

Flexibility is defined as the range of motion (ROM) at a single joint or a series of joints (Alter, 1996) and ROM can reflect the ability of muscles and connective tissue surrounding the joint to be elongated within their structural limitations (Borms and van Roy, 2001). According to Maud and Foster (2006), because flexibility is joint specific, comprehensive flexibility assessment would involve measurement of all joints which would be extremely time consuming and impractical. Field tests of measuring flexibility have been widely used to measure trunk, hip and back flexibility and Borms and van Roy (2001) continue to highlight 'linear' and indirect measurements as the most popular methods which have been adopted for worldwide use. As poor hamstring and lower back flexibility is considered to be a cause of health problems (low back pain), many field measures involve assessing the ROM at the hip joint. The most commonly used method of assessing the trunk flexibility is the sit and reach test originally developed by Wells and Dillon in 1952. Although the sit and reach test has many positive attributes; simple instructions, low cost and high reproducibility (Borms and van Roy, 2001), the test has faced some criticism. Citing the work of others both Borms and van Roy (2001) and Safrit (1990) suggest that individuals with certain anthropometric characteristics (i.e. long arm and short legs) tend to be advantaged over others.

Flexibility can be assessed directly by means of goniometry. Goniometry can be either two- or three- dimensional which is, according to Borms and van Roy (2001), constrained within a mechanistic approach whereby articulating limbs rotate around a fixed axis that coincides with the axis of the goniometer. Goniometers can be either standard (like a protractor in appearance) or clinical (otherwise known as an inclinometer). However, this method is only reliable and accurate when in the hands of an experienced individual with an excellent knowledge of anatomy and anthropometry (Borms and van Roy, 2001). However, Bird and Davison (1997) suggests that a more reliable direct measure of static flexibility in children can be achieved by using a flexometer. The Leighton Flexometer is strapped to the body segment being tested and records movement while in any position which is more than twenty degrees from horizontal. The device consists of a weighted 360 degree dial and a weighted pointer. The dial can be locked in one extreme position (e.g. full flexion of the elbow) and the pointer locked in the other extreme position (e.g. full extension of the elbow) (Maud and Foster, 2006). Norms for joint range of motion using the flexometer have been published for adult males and females (Maud and Foster, 2006). However, norms for children and adolescents are as yet unavailable.

Although direct measurement of flexibility by means of goniometry and Leighton Flexometer are recommended, indirect linear measurements are deemed as suitable for non-performance orientated testing. The sit and reach test provides an inexpensive method of flexibility assessment requiring little expertise and equipment and provides a valid and reliable measure of lower back and hamstring flexibility. Furthermore, due to the fact that flexibility is a complex component of physiological fitness, measurement procedures have remained relatively simple (Borms and van Roy, 2001).

2.4 Measures of attitudes towards physical education

Previous literature indicates that the importance of forming positive attitudes towards curriculum physical education has been recognised with changes being made to the PE programme in schools (e.g. the implementation of health related fitness) (Jones, 1988). However, until recently pupils' attitudes towards physical education have only been assessed by subjective means and it has been suggested that there is a need for the objective measurement of attitudes towards curriculum PE using reliable and valid instruments (Jones, 1988). According to Shropshire (1997), open-ended response techniques make the quantification of data difficult and the comparison between child population groups fraught with difficulties.

Attitude towards PE can be established using different approaches; quantitative and qualitative. With reference to quantitative measures a number of instruments have been designed. However, it has previously been reported that it difficult for researchers to make decisions on the appropriateness of the research tool due to the fact that many studies do not fully outline the procedures used to establish reliability and validity (Silverman and Subramaniam, 1999).

In a review of literature regarding children's attitudes toward physical education (PE), Shropshire (1997) found no single instrument available that was appropriate for measurement of children's attitudes toward curriculum PE. Several reasons why existing questionnaires were inadequate at measuring children's attitudes towards PE were also identified (Shropshire, 1997). It was felt that available questionnaires failed to deal with PE specifically and focused on attitudes towards physical activity (e.g. Brustads, 1993; Simon and Smoll, 1974) or sport outside of school (e.g. Wankel and Pabich, 1982). Shropshire (1997) considered it inappropriate to utilise a questionnaire designed for a different population group; i.e. adults, children of a different age group, or children in another country (e.g. Demirhan and Altay, 1999). More recently, another instrument to assess young people's attitude towards PE has been developed by Subramaniam and Silverman (2000). However, the validity and reliability of this questionnaire was established amongst a North American population with older pupils from a different school system and, therefore, the appropriateness of this method for use with British school pupils can be questioned.

A questionnaire devised by Jones (1988), Attitude towards Curriculum PE (ATCPE) scale, was designed for use in British schools by teachers. The questionnaire was a 25 item Likert type scale assessing children's general attitudes towards curriculum PE. According to Jones (1988), the scale has been found to possess acceptable levels of test-retest reliability and internal consistency. However, the questionnaire was designed for use with primary aged children as young as nine years and the scale is too general as it does not have the factorial structure and therefore fails to examine any underlying constructs (Shropshire, 1997).

The Pre-Adolescent Attitude towards Physical Education Questionnaire (PAAPEQ) (Shropshire, 1997) was developed specifically to provide a reliable and valid instrument which would successfully measure pre-adolescent British schoolchildren's attitudes towards PE. The questionnaire was rated on a four point Likert type scale and was composed of 23 items in five factors (general interest, assessment, teacher, environmental adjustment and organisational choice). The PAAPEQ has been shown to possess high internal consistency ($a=0.80$) and high inter-item reliability ($p<0.001$) making it suitable for future research into the attitudes of pre-adolescent children towards school PE.

Although the majority of research conducted on student attitude has used quantitative techniques (Silverman and Subramaniam, 1999), increasingly literature advocates a more qualitative approach and largely interviewing as a research tool has been employed (e.g. Carlson, 1995). However, interviewing techniques have their own complexities. With reference to interviewing in general interviewer bias and the interpretation of data collected are key issues in validity. Nevertheless, the researcher can employ a variety of methods to increase the validity of the data collected including triangulation. Additionally, when carrying out attitude research using interviews with younger children, an inability to verbalise responses can affect the validity and reliability of responses provided (Silverman and Subramanian, 1999).

2.5 Classification of ethnicity

According to Bonnett and Carrington (2000), the collection of ethnic and racial statistics has become commonplace in a variety of institutional settings. The Department for Education and Skills (DfES) and Local Education Authorities (LEAs) can be included in the list of organisations that collect data on ethnic groups. During the late 1960s and early 1970s the then Department for Education and Science (DES), began collecting data on immigrant children in British schools due to the possible effect ethnic diversity had on schools (Bonnett and Carrington, 2000). However, with time, the ethnic classification system adopted by government agencies has evolved. The original three category typology (West Indians, Asians and Other School Leavers) was widely criticised during the 1980s due to its limited number of categories and consideration only of ethnic minority groups (Bonnett and Carrington, 2000). Until recently the revised ten ethnic category typography (White, Black Caribbean, Black African, Black Other, Asian Indian, Asian Pakistani, Asian Bangladeshi, Asian Chinese, Asian Other, Other), utilising the Office of Population Censuses and Surveys (OPCS) system for the 1991 Census, was used by the DfES. Although an improvement on the three category system, the categories of the OPCS are similarly flawed (Bonnett and Carrington, 2000).

According to Bird (1996), it is inappropriate that the classification system treats 'White' as a unitary category. The use of a broad white ethnic category is limited and does not differentiate between very distinct sub-groups of this category. For example, White British, White Irish, Traveller children and those of East European heritage. It can also be suggested that people from mixed ethnicity parentage are not accommodated in ethnic classification data. Irrespective of the ethnicity of their parents all respondents would be classified in the 'other' ethnic category. However, many LEAs have utilised an extended list of categories for local planning and delivery which, for national reporting, collapse back into the Census categories (Jackson, 2003).

Since the start of 2003, the DfES has adopted categories which are based closely on the 2001 National Population Census (England) categories with the exception of two categories to help improve data on Traveller children. These data were then utilised for the Pupil Level Annual Schools' Census (PLASC). The new categorisation system goes some way to address the concerns of Bird (1996) and Bonnett and Carrington (2000) with reference to previous ethnic category systems used. Furthermore, the information gained from the PLASC would provide better information on the attainment of pupils from different ethnic backgrounds (DFES, 2002). However, these new categories will only apply to new school entrants from January 2003.

It has previously been suggested by Bradby (2003) that fixed response categories place too much emphasis upon the homogeneity within groups and contrasting these groups. Therefore, it has been advocated that respondents should provide a self description of their ethnicity (Rankin and Bhopal, 1999). Rankin and Bhopal (1999) found little agreement between self descriptions provided by people from South Asian origin and the ethnicity they assigned themselves to using the 1991 census categories. However, a large number of ethnic categories would make comparisons problematic. In fact it has been the recommendation of the DfES (2002) that LEAs do not include ethnic categories which are likely to "contain fewer than 100 pupils within the authority as a whole across all year groups" (p.4). A number of ethnic categories (as well as the classification of young people according to age and gender) would result in relatively small cell sizes. Therefore, it would be inappropriate to make statistical inferences regarding physical activity, attitude towards PE and fitness levels based on relatively small numbers of subjects. As a result, three broad ethnic categories are deemed more appropriate: white, black and Asian. These categories are based upon the ethnic categories people assigned themselves to in the 1991 Census data. Furthermore, although extended lists of ethnic categories are adopted by some LEAs, data is easily accessible via school records and categories collapse back into Census classification systems categories which would in turn fall into three broad categories.

3.0 METHODOLOGY

3.1 Research design

This study examines the physical activity levels, attitude towards physical education and health-related physical fitness of young people according to ethnicity, gender and school year and consists of two phases: initial and follow-up phases. The initial phase (hereafter referred to as phase one) and follow-up phase (hereafter referred to as phase two) of data collection occurred twelve months apart to establish changes in the physical activity levels, attitude towards physical education and health-related physical fitness within participants. Data collection was conducted throughout the academic year (i.e. Autumn, Spring and Summer terms) to avoid seasonal variation in physical activity patterns.

Developmental research enables the comparison of behaviours across age ranges. Data can be gathered through cross-sectional and longitudinal designs (Thomas, Nelson and Silverman, 2005). Longitudinal study aims to "collect data at different points in time so that changes can be observed in the measured variables" (Williams and Wragg, 2004: 39). Longitudinal designs are deemed more powerful than cross-sectional designs as behaviours are observed in the same participants over time as opposed to different participants of different age groups at the same point in time (Thomas, Nelson and Silverman, 2005). As the decline in childhood physical activity with age is of significance in physical activity research and previous studies have largely tended to adopt a cross-sectional approach to data collection, longitudinal studies help to identify whether there is indeed a downward trend in young people's physical activity. However, it is recognised that longitudinal research designs are more time consuming to conduct and that there are additional issues to consider such as participant attrition (Gratton and Jones, 2004). Therefore, a short longitudinal approach was taken whereby participants from three National Curriculum school years would be measured twelve months apart. This approach enabled comparisons between three school cohorts whilst studying the changes in individual cohorts over time, as previous research has indicated that young people's physical activity declines with increasing age (e.g. Harris, 1998; Pate et al., 1994).

The methods employed to assess the independent variables (IV) of ethnicity, gender and school year were chosen as they were the most appropriate in terms of practicality and accuracy. Physical activity, physical fitness and attitude towards the subject of physical education were the dependent variables (DV) and measured in the field within the confines of participant secondary schools. For each hypothesis, a statistical significance level of $p<0.05$ was used as is common practice for a study of this kind within the social sciences (Gratton and Jones, 2004). Therefore, it will only be accepted that there is a genuine difference or relationship if there is a less than 5 per cent probability that it could have occurred by chance (Williams and Wragg, 2004).

3.1.1 Research ethics

The study was approved by the College Research and Ethics Committee prior to data collection.

Consent was obtained from the LEA (see Appendix I) prior to identifying and contacting individual schools. Informed consent was obtained from headteachers of the participating schools and members of school staff were briefed on the nature of the study. Written informed consent was required from the parents or legal guardians of the participants prior to data collection. Sample letters to headteachers of participant schools and consent letters to parents/guardians can be found in appendices II and III respectively. If the children did not give their assent to participate, parents were not contacted. It has previously been suggested that both parent and child should provide consent as it is important that the young people themselves are willing participants (Armstrong and Welsman, 1997). Participants and their parents or legal guardians were advised in writing that the participants could withdraw from the research at any time and that all information and data collected were confidential.

3.1.2 Pilot studies

Pilot studies were conducted to establish the suitability of chosen measures of physical activity and attitude towards physical education.

3.1.2.1 Measurement of physical activity

The measure used to assess physical activity, the four by one-day recall questionnaire, was initially designed to be interviewer administered to one respondent at a time. However, due to the size of the sample in this study, a pilot study was conducted to assess the possibility of administering the questionnaire to small groups of respondents. After conducting a pilot study with small groups of 11 year-olds (the youngest age to participate in this study) it was found to be both practical and appropriate to administer the questionnaires to groups of no more than six respondents in order to ensure that the interviewer could oversee that all questions were being answered in sufficient detail. The completion of questionnaires in groups also provided respondents with opportunities to discuss issues pertaining to time and duration of school-based activity (e.g. the duration of the PE lesson). Intraclass correlations for estimates of average daily energy expenditure between weekdays one and two indicated satisfactory reliability ($R=0.73$, $p<0.01$).

3.1.2.2 Measurement of attitudes towards PE

The Pre-Adolescent Attitude towards Physical Education Questionnaire (PAAPEQ; Shropshire, 1997) has previously been found to possess high internal consistency, a valid factor structure and high inter-item reliability (Shropshire and Loumidis, 1996) and was therefore deemed appropriate for use in this study. Results of intraclass correlations conducted on data collected from a two week test retest reliability study of 73 young people (33 boys and 40 girls, mean age ± S.D. = 12.4 ± 0.7 years) from a Birmingham Local Education Authority secondary school indicated that the PAAPEQ is reliable ($R=0.88$, $p<0.01$). Furthermore, the concurrent validity of the PAAPEQ with an alternative measure of attitude towards PE was established. The 20 item instrument devised by Subramaniam and Silverman (2000) had previously been validated amongst North Americans of an age similar to participants in the current study (i.e. 12 to 14 years). The same pilot sample completed both attitude towards questionnaires on the same day using a counterbalanced design; half the participants completed the PAAPEQ first followed by the Subramaniam and Silverman (2000) questionnaire and the remaining half completed in reverse. Pearson's correlation coefficient found the two questionnaires to have concurrent validity ($r = 0.71$, $p<0.01$).

3.2 Sample

3.2.1 Sample for phase one

Five hundred and fifteen children were sampled. Of these, three hundred and ninety four children (134 boys and 260 girls) took part in phase one of the study. The remaining children did not provide parental consent or had incomplete physical activity data (i.e. they were absent for one or more days of physical activity data collection). Participants were secondary school aged children attending schools (n=6) within the City of Birmingham Local Education Authority (LEA). To ensure that subgroups were adequately represented in the final sample, participant schools were targeted in collaboration with the LEA according to the ethnic diversity of their pupils. Participants were aged between 11 and 14 years from school years 7 (n = 133), 8 (n = 125) and 9 (n = 136) (mean age ± S.D. = 12.9 ± 0.81 years). Participants were categorised into three broad ethnic groups: white (n = 211), black (n = 42) and Asian (n = 141) according to data held by participant schools. At the time of data collection, the ethnic group percentages for Birmingham were as follows: white 70.4%, black 6.1% and Asian 19.5% (2001 Census data, National Statistics Online, 2006) and therefore, the number of participants in each ethnic group were broadly representative of ethnic group percentages for Birmingham. The ethnic categorisation system used was based upon that which is used by the LEA and a modification of the 2001 Census ethnic categories. This system will be clarified in a later section.

Individual subjects within the participating schools were selected according to school organisation and timetabling. Informed consent was obtained from headteachers of the participant schools and from the parents or legal guardians of the participants. If the children did not give their assent to participate, parents were not contacted. Given that participants provided their assent to take part in the current study, the representativeness of the data can be questioned as only those pupils who considered themselves to be active and fit may have agreed to participate.

All participants completed physical activity and attitude toward physical education assessment. Systematic sampling was used to identify a sub sample (35%) of the overall sample who would undergo health-related physical fitness testing. Systematic sampling is based on the same principles of random sampling but "introduces some system into the selection of people" (Denscombe, 1998: 12). Therefore, for each participating school every third participant was identified according to school year.

3.2.2 Sample for phase two

Two hundred and sixty seven secondary school children (102 boys and 165 girls) took part in phase two of the study (68% of the phase one sample). The remaining 32% had either left the school, were absent for one or more days of data collection, did not give assent or did not provide parental consent to take part in the study. The sample was drawn from school years 8 (n = 99), 9 (n = 87) and 10 (n = 81) and were therefore aged between 12 and 15 years (mean age ± S.D. = 13.7 ± 0.79 years). Informed consent was again obtained from headteachers and from parents or legal guardians. Sample letters to headteachers inviting participant schools to again take part in the study and letters to parents/guardians requesting consent to allow their child to take part in phase two of the study can be found in Appendices IV and V respectively. If children did not give their assent to participate, parents were not contacted. The same ethnic grouping system used for phase one of the study was applied. Numbers of participants in each ethnic category were as follows: white (n = 134), black (n = 33) and Asian (n = 100).

Measurement of physical fitness was carried out with the same sub sample from phase one (sub sample for phase two 26% of the overall sample).

To establish whether young people who participated in both phases of the study were representative of the original sample (including those who did not participate in phase two of the study), analyses were conducted on phase one data. Independent t test was applied to: energy expenditure data, total attitude towards PE data, and selected health-related fitness variables (i.e. cardiovascular fitness and measures of body composition); Mann-Whitney U test was applied to data for time spent in moderate and vigorous activity. Findings revealed no significant difference in physical activity between the two groups of participants according to energy expenditure ($t_{(392)}$ = -.30, p>0.05), and time spend in moderate (Z = -.02, p>0.05) and vigorous (Z = -.17, p>0.05) activity. No significant difference in attitude towards PE was also found ($t_{(392)}$ = 1.74, p>0.05). In addition, those who participated in phase two of the study were not found to have different cardiovascular endurance ($t_{(136)}$ = .46, p>0.05), BMI ($t_{(136)}$ = -.58, p>0.05), or percent body fat ($t_{(136)}$ = -.39, p>0.05) than non-participants.

3.3 Measurements and procedures

All the measures used in phase one of the study were applied in phase two.

3.3.1 Measurement of physical activity

Level of physical activity was measured by means of the four by one-day physical activity recall questionnaire (Cale, 1993). The questionnaire was designed for British children over the age of 11 years (and therefore appropriate for the age of participants in this study) and the reliability (r=0.62) and validity (r=0.61 and r=0.79 for heart rate monitoring and observation respectively) have previously been established (Cale, 1994). The questionnaire was also designed to be interviewer administered to aid in the recall of information which has previously been advocated (Freedson, 1989; Montoye and Taylor, 1984[31]). Furthermore, the questionnaire can be analysed in many different ways to yield information of physical activity

[31] Montoye, H.J. and Taylor, H.L. (1984) Measurement of physical activity in population studies: a review. Human Biology, 56:195-216. Cited in Armstrong and Welsman (1997:104)

including energy expenditure and time spent in moderate and vigorous activity.

The four by one-day recall questionnaire consisted of two forms: a school day form (Appendix VI) and a weekend form (Appendix VII) that recalled only the previous day's activity (one-day recall). Questionnaires were administered in accordance with the four by one-day protocol and instruction manual (Cale, 1993). Data were collected on a Monday (when respondents recalled activity over the weekend) and two weekdays. Interviews took place in an unused classroom or gymnasium (dependent upon school organisation) and respondents were sat at desks or on benches with the interviewer opposite and in a position to see written responses to the questions (see Appendix VIII). Incomplete data sets were excluded.

Once completed, daily energy expenditure (kcal kg^{-1} day^{-1}) was calculated based upon the procedure used in the 7-day recall described by Blair (1984) and adopted by Cale (1993). The metabolic costs adopted for use in this questionnaire are expressed in the form of METs which is the ratio of work metabolic rate to resting metabolic rate (the amount of energy the body uses during activity proportional to energy used at rest). Average daily time spent in moderate and vigorous intensity physical activity was also calculated in accordance with Cale (1993). Sample four by one-day recall questionnaire summary sheets to enable the calculation of daily energy expenditure and the amount of time spent in moderate and vigorous activity for school days and weekend days can be seen in appendices IX and X respectively.

Previous research using this measure of physical activity has largely ignored the measures of daily energy expenditure taken individually (i.e. weekday 1, weekday 2, Saturday and Sunday). In the present study measures of daily energy expenditure for the four days were analysed as well as the average daily energy expenditure across the week.

3.3.2 Measurement of attitude towards physical education

Attitude was measured using the Pre-Adolescent Attitude towards Physical Education Questionnaire (PAAPEQ; Shropshire, 1997). The PAAPEQ was developed specifically to provide a reliable and valid instrument that would successfully measure pre-adolescent British schoolchildren's attitudes towards curriculum PE and it is, as far as Shropshire (1997) is aware, the only questionnaire designed specifically for this purpose. The PAAPEQ has previously been found to possess high internal consistency (α = 0.80), a valid factor structure and high inter-item reliability ($p<0.001$) (Shropshire and Loumidis, 1996) and was therefore deemed appropriate for use in this study.

The PAAPEQ is a 23 item questionnaire consisting of five factors (see Appendix XI). The first factor, general interest, consists of nine items and is a measure of motivation, enjoyment and value for PE. The assessment factor (4 items) is a measure of how assessment is perceived and how different methods of assessing are valued. The teacher factor consists of four items and provides a measure of how the actions of the teacher are perceived by pupils. The environmental adjustment factor (4 items) provides a measure of how certain environmental factors affect pupils' enjoyment of PE. The final factor, organisational choice (2 items) measures how interest in PE can be affected by offering more organisational choice. Participants were required to respond on a four point Likert type scale ranging from "very true" to "not at all true" where one point indicates low interest or dissatisfaction. In accordance with the guidelines of the creator, items were expressed both positively and negatively to avoid a positive response set and negative statements were recoded (Shropshire, 1997). The questionnaire was administered to the whole sample in small groups of no more than six respondents.

Following completion, questionnaires were decoded to provide totals for each of the five factors as well as a total score for attitude towards physical education.

3.3.3 Measurement of health related fitness

Five components of health related fitness (body composition, cardiovascular endurance, flexibility, muscular strength and muscular endurance) were measured in a randomly selected sub sample of the overall sample using the following methods and procedures. All measurements of health related fitness were completed in one day for individual participants and in accordance with recommended guidelines (Bird and Davison, 1997). All measurements were conducted in indoor school sporting facilities (i.e. school gymnasia) and the same researcher carried out the health related fitness testing. Participants were informed of the nature of each of the different measures and these were demonstrated to the pupils by the researcher and participants were asked to complete each measure to the best of their ability. Anthropometric measurements were taken first, followed by measures of muscular strength and endurance, and flexibility. Cardiovascular endurance was measured last. Values were recorded on the profile sheet (Appendix XII) by the researcher.

3.3.3.1 Body composition assessment

To be able to calculate body composition and BMI, the height (cm) and weight (kg) of the participants were assessed using Seca stadiometer and Seca weighing scales (Seca Instruments Ltd, Germany). Participants were measured in minimal clothing (i.e. school PE kit for indoor activities) and were requested to remove footwear. Body height was measured to the nearest 0.5 cm and body weight to the nearest 1.0 kg.

Percentage body fat was assessed by means of skinfold thickness measurement at two sites (triceps and medial calf) and calculated using the child-specific skinfold equation devised by Slaughter et al. (1988). Harpenden skinfold callipers (Harpenden Instruments Ltd, London) were used to take skinfold measurements and were set to zero prior to measurement. Measurement sites were marked on the right hand side of the body using a water based marker. The triceps site was marked and measurement taken at the midway point between the acromion process (shoulder) and the olecranon process (elbow). Medial calf measurement was marked then taken from the maximal circumference of the calf with the participant's hip and knee flexed to an angle of 90°. Skinfolds were measured twice. As literature has previously recognised limitations in the use of the triceps calf skinfold equation (Slaughter et al., 1988) amongst children and young people (Janz et al., 1993), BMI was also calculated and data analysed to support any results obtained as a result of skinfold measurement.

3.3.3.2 Cardiovascular endurance assessment

Cardiovascular fitness was measured using the twenty-metre multistage fitness test (Brewer et al., 1988). The course was set up in accordance with the recommended guidelines (Brewer et al., 1988) and the relevant checks prior to administration of the test were carried out. No more than ten participants at a time were requested to line up at one end of a twenty-metre course and were advised to listen carefully to the instructions on the tape. Participants were informed to continue walking and not to sit down when they dropped out of the test and told to report to the investigator to ensure the level and stage that was reached by individuals was recorded. Estimated peak VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$) was calculated using published conversion tables included within the test.

3.3.3.3 Measurement of flexibility

The sit-and-reach test (expressed in centimetres) was used to measure the flexibility of the hamstrings and lower back. After completing five minute aerobic warm-up including static hamstring stretches (lead by the researcher), participants were requested to remove footwear and sit with their feet flat against the sit and reach box (Lafeyette Instrument Co. Europe, Loughborough). The researcher placed their hands over the knees to prevent flexing and the participants were instructed to lean forward slowly and continuously push the marker along the box with both hands until they could push no further. Each participant was given two attempts and the best score taken.

3.3.3.4 Measurement of muscular strength

Muscular strength was determined using a digital hand grip dynamometer (Takei Instruments Ltd, Japan). The grip strength of both dominant and non-dominant hands was measured and the force of the contraction recorded in kilograms. The grip was adjusted for the hand size of each participant. Participants were instructed to continually squeeze the dynamometer whilst lifting their arm to shoulder height with their palms down. The participant was allowed two attempts and the highest value recorded.

3.3.3.5 Measurement of muscular endurance

Muscular endurance was assessed by means of the total number of sit-ups completed in 30 seconds (timed by the investigator using a stop-watch). Participants were instructed to fold their arms across their chest with hands on opposing shoulders with their knees bent (feet were anchored). One complete sit-up consisted of touching the knees with the elbows and returning to the start position ensuring that the shoulders are in contact with the mat.

3.3.4 Ethnicity classification

Participants were categorised into three broad ethnic groups: white, black and Asian according to data held by participant schools. The ethnic categorisation system used was based upon the categories that people assigned to themselves in the 1991 census. The white group incorporated people classified as white British, white Irish and white other. The black category contained black Caribbean, black African and black other groups. Finally, the Asian group included those of Indian, Pakistani, Bangladeshi, Chinese and other Asian heritage.

It is recognised that the grouping of participants into three broad ethic groups can be considered limited when extended lists of ethnic categories are frequently used. However, it has previously been advocated that ethnic categories should not be used when numbers of pupils in that group are below a critical value across year groups (DfES, 2002). As the focus of current study was to establish the simultaneous effects of ethnicity, school year and gender, the use of more ethnic categories would have resulted in small cell sizes not conducive to statistical analysis.

3.3.5 School year coding

Due to the fact that participants were measured twice, twelve months apart, and subsequently would move from one National Curriculum school year into another between phase one and phase two of the study (i.e. year 7 into year 8, year 8 into year 9 and year 9 into year 10), it was decided that a coding system be used to aid in the reporting of findings. This coding system referred to school cohort and not National Curriculum school year. For example, participants who were in Year 7 during phase one and therefore moved into Year 8 during phase two would be coded Year A. Please see Table 2 for the full details of school year coding.

Table 2. School year group coding

School Year during phase one	School year during phase two	Cohort Coding
Year 7	Year 8	Year A
Year 8	Year 9	Year B
Year 9	Year 10	Year C

3.4 Analysis

Physical activity (in terms of average daily energy expenditure, time spent in moderate and vigorous intensity activity, physical activity status and percentages meeting current activity guidelines), physical fitness and attitude towards PE data was analysed according to ethnicity, school year and gender. Furthermore, data were analysed to establish relationships between physical activity (average daily energy expenditure and time spent in moderate and vigorous intensity physical activity) and both attitude towards PE and physical fitness. Statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS) version 11. For all statistical analyses, the significance level was set at $p<0.05$ as is conventional for a study of this nature (Gratton and Jones, 2004).

3.4.1 Analysis of physical activity data

3.4.1.1 Daily energy expenditure

Following scoring and completion of all physical activity data, average daily energy expenditure was compared using 3 x 2 x 3 (ethnicity x gender x school year) repeated measures analysis of variance (ANOVA) using backwards elimination to achieve a parsimonious solution. Backwards elimination was achieved by removing those factors which did not add significantly to the model. Where significant differences were found between independent variables, Tukey's HSD post hoc multiple comparisons were used to indicate where these differences lay. Between subject factors were ethnicity, gender and school year. Within subject factors were days of the week (weekday 1, weekday 2, Saturday, Sunday) and time (phase one and phase two). Recognising that physical activity data were positively skewed and not satisfactorily normally distributed, a logarithmic transformation was used to overcome the skewness in the data. In addition, data were subjected to non-parametric methods to confirm the results from repeated measures ANOVA using the log transformed data.

3.4.1.2 Time spent in moderate and vigorous physical activity

Due to the fact that data (i.e. time spent in daily moderate to vigorous activity) did not meet requirements for parametric tests, the Kruskall Wallis test for independent samples was carried out on data sets from each phase of data collection. The Wilcoxen signed ranks test for related samples was used to compare phase one and phase two of the study.

3.4.1.3 Physical activity status

Based on mean daily energy expenditure, young people were classified into one of the four activity categories (very inactive, inactive, moderately active and active) represented in Table 3 for both phase one and phase two of the study. The physical activity status of the whole sample and sub-samples (percentages and numbers) for phase one and phase two was calculated.

Table 3. Classification system adapted by Cale (1993) from the 7-day recall (Blair, 1984)

Activity Score (kcal kg^{-1} day^{-1})	Activity Status
Less than 33	Very Inactive
Between 33-36.9	Inactive
Between 37-39.9	Moderately Active
40 or greater	Active

3.4.1.4 Percentages meeting current activity guidelines

The percentage of the overall sample and sub samples meeting recommended guidelines for physical activity for health was calculated; that being, young people should accumulate at least thirty minutes of moderate to vigorous intensity activity daily (NIH, 1996; HEA, 1998) and those who already attain this level should accumulate one hour of MVPA daily (HEA, 1998). In this study, moderate activity was calculated from the amount of time reported in activities with an energy cost of four METs, while vigorous activity was calculated from time reported in activities with an energy cost of more than six

METs. This procedure was again carried out for both phases of data collections.

3.4.2 Analysis of attitudes towards physical education data

Although attitudinal scales tend to result in ordinal level data, the current study used the sum of items in questionnaire factors with up to nine items, thus data were deemed suitably interval, and therefore Mean ± SD were used as measures of central tendency and variability. Descriptive statistics (Mean ± SD) were calculated for each of the five PAAPEQ factors (general interest, assessment, PE teacher, environmental adjustment and organisational choice) and total attitude towards PE for the whole sample and according to the independent variables of ethnicity, gender and school year.

To establish the effect of the independent variables on attitude towards PE for each of the five attitude factors a 3 x 2 x 3 (ethnicity x gender x school year) multivariate analysis of variance (MANOVA) was used. MANOVA determines the simultaneous effects of independent variables, and interactions, upon more than one dependent variable while protecting against type I errors (Thomas, Nelson and Silverman, 2005; Vincent, 2005). A reduction in experimentwise error is achieved by the formation of a new dependent variable from the linear composite of several dependent variables which is then statistically analysed. If significant differences in the newly formed dependent variable are found, then further analysis of the original dependent variables is justified (Vincent, 2005). Therefore, multivariate analysis explored whether the combined factors of the PAAPEQ differed due to the three independent variables of ethnicity, gender and school year and univariate analysis was conducted to establish exactly which of the five attitude factors are affected by the independent variables. To establish this, the backward selection procedure was applied whereby all dependent variables are entered into the model and the one factor contributing the least is removed (Thomas, Nelson and Silverman, 2005). Analysis continues until the only variables that remain are those which contribute significantly to the model (i.e. $p<0.05$). Where between subject differences were revealed, Tukey's post hoc multiple comparisons were used to identify where these differences lay.

3.4.3 Analysis of health related fitness data

Measures of physical fitness were analysed using a 3 x 2 x 3 ways repeated measures ANOVA with backwards elimination to achieve a parsimonious solution. Between subject factors were ethnicity, gender and school year. The within subject factor was time (phase one and phase two). Descriptive statistics were also calculated for each of the variables.

3.4.4 Relationship between physical activity and attitude towards physical education

Pearson's Product Moment correlations were used to confirm the strength of any relationships between physical activity levels (energy expenditure and time spent in daily MVPA) and attitude towards PE. Data were analysed according to the independent variables of ethnicity, gender and school year. This procedure was repeated for phase one and phase two of the study.

3.4.5 Relationship between physical activity and health related fitness

Pearson's Product Moment correlations were used to determine the nature of any relationships between physical activity levels (energy expenditure and time spent in daily MVPA) and health related fitness variables. Data were analysed according to the independent variables of ethnicity, gender and school year. This procedure was repeated for phase one and phase two of the study.

4.0 RESULTS

4.1 Young people's physical activity

All analyses relating to young people's physical activity, that being average daily energy expenditure (kcal kg^{-1} day^{-1}) and average time spent in moderate and vigorous activity (min.), were carried out on data collected during phases one and two using the one-day physical activity recall questionnaire (Cale, 1993). The results of young people's physical activity levels will therefore be reported and analysed in terms of average daily energy expenditure, time spent in moderate and vigorous activity, physical activity classification and percentages of sample and sub-samples meeting physical activity guidelines.

4.1.1 Daily energy expenditure

Energy expenditure data, analysed using a 3 x 2 x 3 repeated measures ANOVA, had the within subject factors of 'time' (i.e. short longitudinal data collection over two years – phase one and phase two of the study) and 'days' of the week (i.e. weekday 1, weekday 2, Saturday and Sunday). Between subject factors were 'school year', 'ethnicity', and 'gender'.

To ensure that weekday energy expenditure was constant across weekdays (i.e. school days), a paired samples t-test was carried out to assess agreement between weekday 1 and weekday 2 data. No significant difference was found between weekday energy expenditure for phase one ($t = -1.4$, df 393, $p>0.05$) or phase two ($t = 1.8$, df 266, $p>0.05$) data collections. Mean energy expenditure values for weekdays 1 and 2 differed by only 0.4 and 0.5 kcal kg^{-1} day^{-1} for phases one and two respectively. Thus, energy expenditure remained relatively stable on school days.

With reference to the within subject factor of ‘days’ of the week, results from repeated measures ANOVA revealed a significant ‘days’ by ‘school year’ interaction ($F_{6,777}$ = 2.3, $p<0.05$). As can be seen in Figure 3, year B pupils reported having the highest average daily energy expenditure for schooldays, followed by those in year A then year C. When compared with mean energy expenditure across all four measurement days (comprising Saturday, Sunday and two school days), average daily energy expenditure was highest for the youngest participants, year A (37±3 kcal kg^{-1} day^{-1}) followed by young people in year B (36±4 kcal kg^{-1} day^{-1}) and then year C (36±3 kcal kg^{-1} day^{-1}). A similar age related decline in mean values was observed for both Saturdays and Sundays with respondents in year A being most active and those in year C least active. In summary, findings indicated that Year B pupils expended more energy during school days than years A and C but during the weekend, energy expenditure decreased with school year (i.e. from Year A to Year B to Year C).

A highly significant ‘days’ of the week main effect was also identified ($F_{3,777}$ = 33.0, $p<0.01$). Average daily energy expenditure across the week, for both phase one and phase two, was found to be significantly higher (all $p<0.01$) on Saturdays than on Sundays or weekdays and mean values for the phase one indicated that overall physical activity was higher on weekends than during the week. Within subject effects for ‘days’ of the week can be seen in Table 4 in Appendix XIV

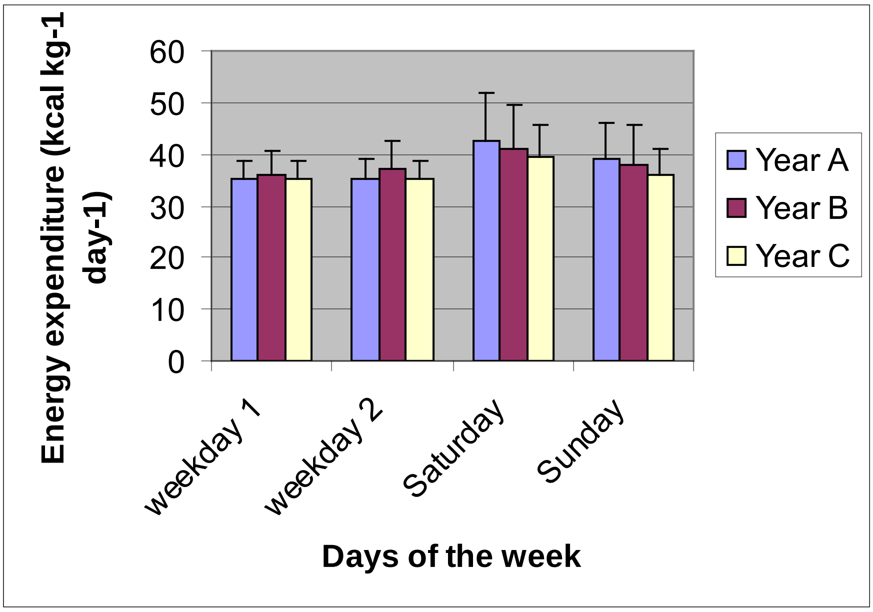

Figure 3. Average daily energy expenditure 'days' of the week by 'school year' interaction

A significant, higher order, 'time' by 'gender' by 'ethnicity' interaction was revealed ($F_{2,259}$ = 4.3, $p<0.05$) (see Figure 4). In phase one, energy expenditure values found black boys to be less active than black girls whereas in phase two it was the black boys who were more active than black girls. Conversely, among white and Asian groups, boys consistently expended more energy than girls.

A highly significant, two-way, 'time' by 'ethnicity' interaction ($F_{2,259}$ = 7.3, $p<0.01$) was also found (see Figure 5). In phase one, white pupils expended more energy than black and Asian pupils. However, data collected in phase two found that as the white pupils had aged, their activity had fallen to the level of black pupils.

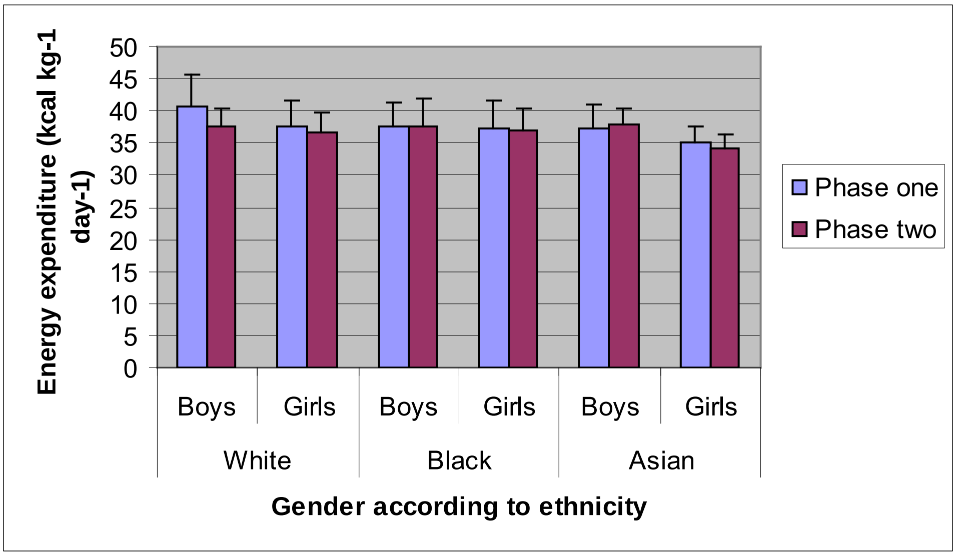

Figure 4. Average daily energy expenditure 'time' by 'ethnicity' by 'gender' interaction

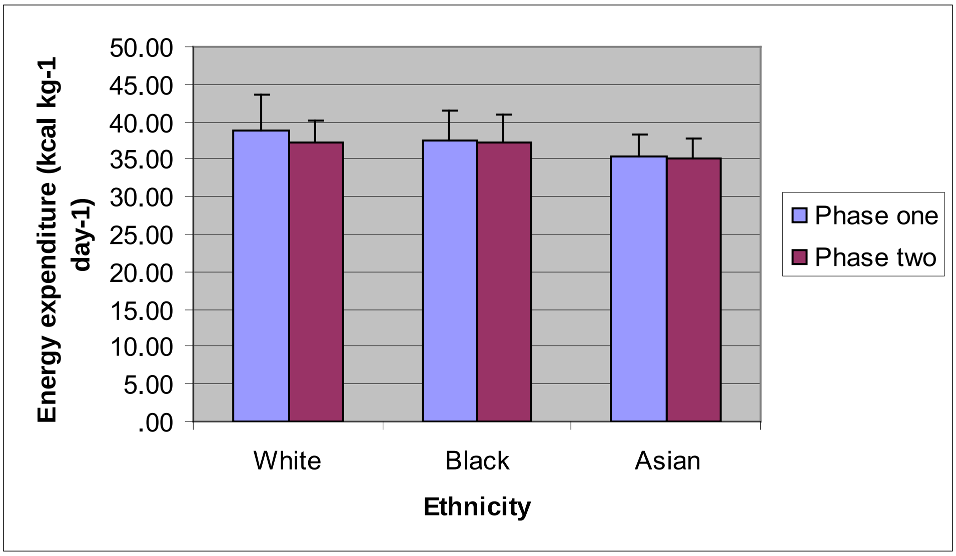

Figure 5. Average daily energy expenditure 'time' by 'ethnicity' interaction

Repeated measures ANOVA also revealed a significant within subjects 'time' main effect between phases one and two ($F_{1,259} = 5.6$, $p<0.05$). Average daily energy expenditure was found to be lower in phase two (36±3 kcal kg^{-1} day^{-1}) than in phase one (38±4 kcal kg^{-1} day^{-1}) indicating that as young people move through secondary school, physical activity levels decrease. Within subject effects for 'time' (longitudinal data collections) are presented in Table 5 in Appendix XIV.

Furthermore, repeated measures ANOVA identified a significant, 'time' by 'days' of the week by 'school year' interaction ($F_{6,777} = 2.2$, $p<0.05$) (see Figure 6). In phase one pupils in year B were found to be significantly more active during weekdays compared to those in years A and C. However, in phase two, as pupils had progressed through the school system and were now in a National Curriculum (NC) year group above that of the previous year (e.g. Year A pupils moved from NC Year 7 into NC Year 8), year B pupils were found to be less active during weekdays than their year A counterparts. Thus, on school days, NC Year 8 was found to be the most active year group of those measured. This would suggest that energy expenditure values on school days are higher for pupils in NC Year 8 than for other years irrespective of the cohort measured. Mean values supported this. For weekday 1, year A mean (±S.D.) energy expenditure increased from 35 (±3) kcal kg^{-1} day^{-1} during NC Year 7 to 37 (±4) kcal kg^{-1} day^{-1} for NC Year 8 which is comparable with year B's values for NC Year 8 (phase one) of 36 (±4) kcal kg^{-1} day^{-1}.

A highly significant, 'time' by 'days' of the week interaction was also revealed ($F_{3,777} = 12.2$, $p<0.01$) (see Figure 7). Mean daily energy expenditure from phase two revealed physical activity levels on Sunday (36±4 kcal kg^{-1} day^{-1}) to be below those of weekday 2 (36±4 kcal kg^{-1} day^{-1}) whereas, in phase one, mean energy expenditure for both weekend days was found to be consistently above weekday values. Within subject effects for ‘time’ by ‘days’ of the week interactions are presented in Table 6 in Appendix XIV.

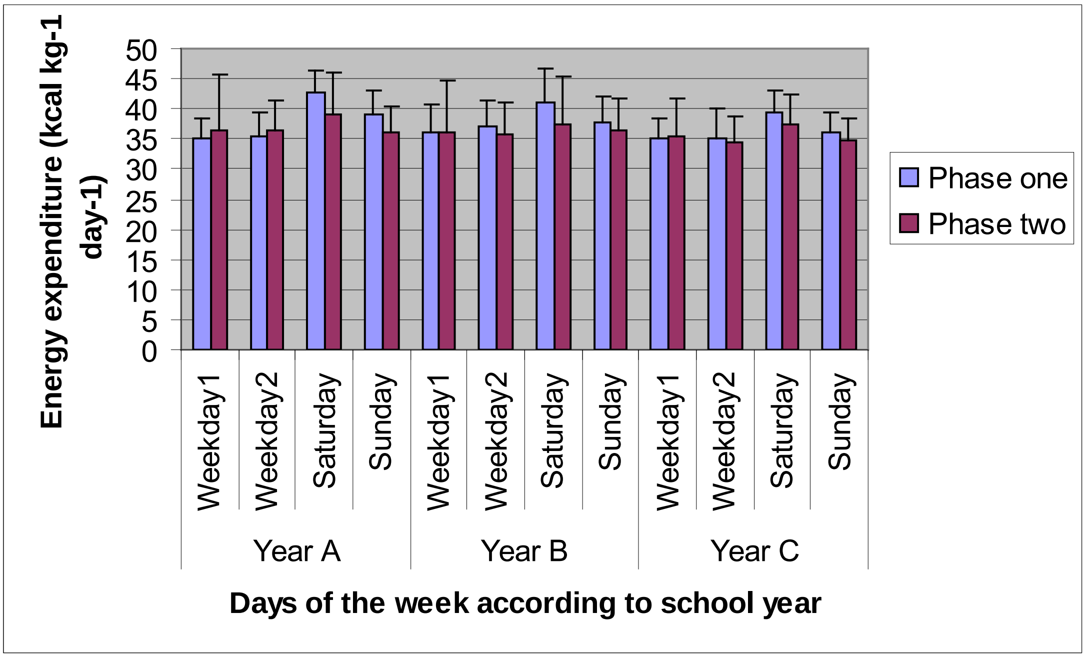

Figure 6. Average daily energy expenditure ‘time’ by ‘days’ of the week by ‘school year’ interaction

With reference to tests of between subject effects, a significant main effect according to ‘gender’ ($F_{1,259}$ = 11.0, p<0.01) was found with boys expending more energy than their female counterparts. Girls expended on average at least 2 kcal kg^{-1} day^{-1} less than boys. Mean (±S.D.) average daily energy expenditure for phase two was 38 (±3) and 36 (±3) kcal kg^{-1} day^{-1} for boys and girls respectively; equivalent to thirty minutes of moderate activity such as brisk walking or badminton.

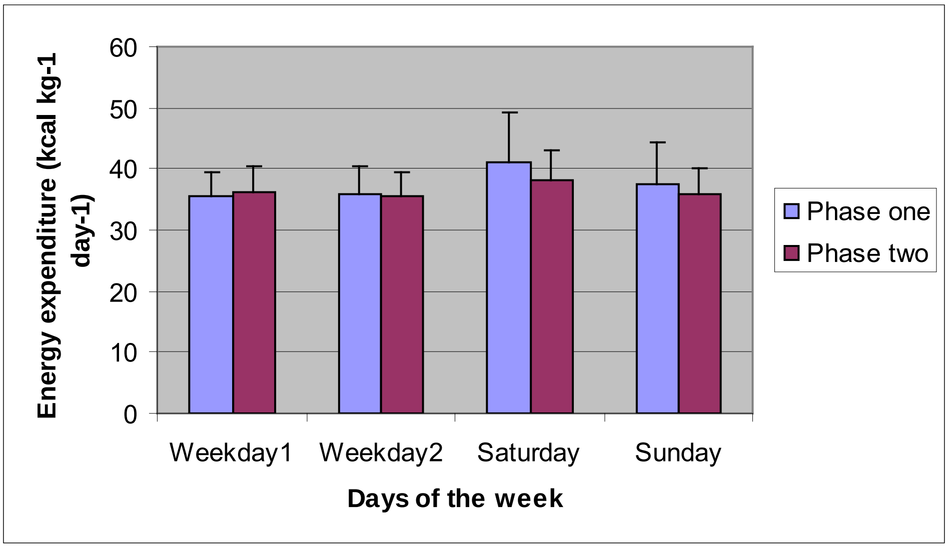

Figure 7. Average daily energy expenditure 'time' by 'days' of the week interaction

A significant 'ethnicity' main effect was also revealed ($F_{1,259}$ = 10.1, p<0.01). Tukey's HSD multiple comparisons found significant differences between white and Asian (HSD = 2.8, p<0.01) and black and Asian groups (HSD = 2.0, p<0.01) but not between young people from white and black groups (p>0.05). Young Asian people reported significantly lower levels of energy expenditure than white and black respondents with a mean (±S.D.) average daily energy expenditure of 35 (±3) kcal kg^{-1} day^{-1}. This value is approximately 2 kcal kg^{-1} day^{-1} less than black and white groups and equivalent to thirty minutes of moderate intensity activity. Results from between subject effects can be seen in Table 7 in Appendix XIV.

Although mean values for average daily energy expenditure for phase two suggest an age related decline in energy expenditure, tests of between subject effects did not reveal a significant main effect according to school year (p>0.05), therefore, energy expenditure was at a similar level for all year groups. Mean (± S.D.) energy expenditure for respondents in year C was 36 ± 2 kcal kg^{-1} day^{-1}, one kcal kg^{-1} day^{-1} less than respondents in year B. The difference in energy expenditure between year B and year C is equivalent to almost thirty minutes of light physical activity such as walking or housework or approximately fifteen minutes of moderate physical activity such as brisk walking, cycling or swimming.

Means and standard deviations for young people's average daily energy expenditure (kcal kg^{-1} day^{-1}) values across 'days' of the week, between phase one and phase two, for the whole sample and according to school year, ethnicity and gender are presented in Table 8 in Appendix XV.

4.1.2 Time spent in moderate activity

Due to the fact that data did not meet the requirements for parametric tests, the Kruskal Wallis test for independent samples was used to assess differences in time (min.) spent in moderate activity according to 'school year', 'ethnicity' and 'gender'.

Analyses conducted on data collected during phase one revealed a significant difference in reported time spent in moderate activity according to 'school year' (χ^2 = 11.1, df 2, p<0.01). Pupils in year A reported spending more time in moderate activity than young people in years B and C. Pupils in year A spent on average thirteen minutes more in moderate activity than those in year B and eighteen minutes more than those in year C. Mean rank for time spent in moderate activity was 222.7, 192.9 and 177.2 minutes for Years A, B and C respectively. However, no such significant difference was found from data collected during phase two ($p>0.05$).

Analyses conducted on both phase one (χ^2 = 18.3, df 2, $p<0.01$) and phase two (χ^2 = 23.8, df 2, $p<0.01$) data consistently found differences according to 'ethnicity'. In phase one, Asian participants were found to engage in fifteen minutes less moderate activity than black, and twenty-four minutes less than white participants. Mean rank for time spent in moderate activity was 218.9, 196.5 and 165.8 minutes for white, black and Asian groups respectively. In phase two, Asian pupils participated in almost thirty minutes less moderate activity than white pupils and almost a quarter of an hour less than black pupils. Mean rank for time spent in moderate activity was 155.0, 135.5 and 105.3 minutes for white, black and Asian groups respectively.

With reference to 'gender', both phase one (χ^2 = 20.2, df 1, $p<0.01$) and phase two (χ^2 = 11.6, df 1, $p<0.01$) found boys spent significantly more time in moderate activity than girls. On average, boys participated in an extra twenty-four minutes during phase one (mean rank for time spent in moderate activity was 233.4 and 179.0 min. for boys and girls respectively). In phase two this difference fell to twenty minutes (mean rank was 154.5 minutes for boys and 121.4 min. for girls). These findings would indicate that although boys engage in more moderate activity than girls, the gap between them narrows as they age and move through secondary school education.

To examine whether the amount of reported time spent in moderate activity changed with time (i.e. between phase one and phase two), the Wilcoxen test for related samples was used. Results of the Wilcoxen test indicated a highly significant difference between the two phases ($Z = -3.2$, df 1, $p<0.01$). During phase two of data collection young people reported spending ten minutes less in moderate activity than previously reported in phase one. Mean ranks for phase one and phase two were 138.2 and 122.1 minutes respectively.

Mean rank, mean and standard deviations for time (min.) spent in moderate activity using data from both phase one and phase two, for the whole sample and according to school year, ethnicity and gender are shown in Table 9 in Appendix XVI.

4.1.3 Time spent in vigorous activity

Kruskal Wallis tests for independent samples were again used to analyse data for any significant differences in time (min.) spent in vigorous activity according to 'school year', 'ethnicity' and 'gender'.

In phase one, a significant difference was identified between respondents in school years A, B and C ($\chi^2 = 22.5$, df 2, $p<0.01$). Year B pupils were found to spend more time in vigorous activity than years A and C thereby supporting the findings of analysis conducted on the energy expenditure data. Mean values indicated that pupils in year B participated in three minutes more than year A pupils and thirteen minutes more than those in year C. Mean rank for time spent in vigorous activity was 217.4, 215.3 and 140.8 minutes for years

A, B and C respectively. Furthermore, a significant difference was found in phase two (χ^2 = 39.9, df 2, p<0.01). Mean values indicated that young people in year A engaged in five minutes more of vigorous activity than year B pupils and almost fourteen minutes more than those in year C. Mean rank for time spent in moderate intensity was 162.0, 139.1 and 94.3 minutes for years A, B and C respectively. Therefore, moderate activity levels fall as pupils' age.

Kruskal Wallis further revealed significant differences according to 'ethnicity' (χ^2 = 61.9, df 2, p<0.01). In phase one, white pupils were found to spend nine minutes longer in vigorous activity than black pupils and almost twenty minutes longer than Asian pupils. Mean rank for time spent in vigorous intensity activity was 233.9, 205.3 and 140.8 minutes for white, black and Asian groups respectively. However, no such difference was revealed for phase two (p>0.05).

In terms of vigorous activity, boys were again found to be significantly more active than girls during both phase one (χ^2 = 56.2, df 1, p<0.01) and phase two (χ^2 = 51.0, df 1, p<0.01). Boys spent on average approximately twenty minutes longer in vigorous activity than girls in both phases. Mean rank for time spent in vigorous activity during phase one was 254.9 and 168.0 minutes for boys and girls respectively and during phase two mean ranks were 174.1 min. for boys and 109.2 min. for girls.

Wilcoxen tests for related samples were again used to analyse data for a significant difference in the time spent in vigorous activity between phases one and two and a significant difference was revealed ($Z = -2.7$, df 1, $p<0.01$). According to mean values, young people reported spending approximately five fewer minutes in vigorous activity during phase two than previously reported in phase one. Mean ranks for phase one and phase two were 89.3 and 98.05 minutes respectively.

Mean rank, mean and standard deviation for time (min.) spent in vigorous activity according to school year, ethnicity and gender for phase one and phase two are presented in Table 10 in Appendix XVII.

4.1.4 Physical activity status

Participants were classified as very inactive, inactive, moderately active and active according to average daily energy expenditure (kcal kg^{-1} day^{-1}). The physical activity classifications are in accordance with protocols devised by Cale (1993) and adapted from the 7-day recall questionnaire (Blair, 1984). The physical activity status of the whole sample and of sub-samples (percentages and numbers) from both phase one and phase two can be seen in Table 11 in Appendix XVIII.

The physical activity status of the overall sample in phase one revealed over half the participants (54.3%) to be classified as inactive or very inactive. Only one quarter (24.1%) of the participants fell into the active category and 21.6% were categorised as moderately active. However, in phase two, the percentage of young people classified as either inactive or very inactive had increased to 63.3%, with only 12.7% of the overall sample classified as active.

Physical activity classification for sub-samples followed a similar pattern. In the case of ‘school year’ an age related decline was observed. Those in year A were more likely to be classified as either moderately active or active than those in year B who, in turn, were more likely to be classified as moderately active or active than those in year C. Similarly, participants in year C were more likely to be classified as inactive or very inactive than in year A. In year A, 45.9% of young people were classified as either inactive or very inactive. This percentage gradually increased across the school years with almost 54% of year C participants being classified as inactive and a further 11% falling into the very inactive activity status category. These findings suggest that with age, young people are becoming less active and are therefore more likely to be classified as either inactive or very inactive. Phase two data supported these findings as pupils were twelve months older than in phase one; 59.6% of year A (an increase of almost 15% on phase 1), 62.1% of year B and 69.2% of year C pupils were classified as either inactive or very inactive.

According to ‘ethnicity’, a greater percentage of white respondents were classified as either moderately active or active than black and Asian participants. In phase one, Asian pupils were the least active with 76.6% falling into the inactive or very inactive categories. Although, in phase two this value increased to 81.0%, the decline in activity was to a lesser extent than white and black pupils. The percentages of white and black pupils classified as inactive or very inactive increased by approximately ten percent between the two phases (i.e. from 39.8 to 50.0% and from 52.4 to 63.7% for white and black groups respectively).

In phase one a lower percentage of girls than boys was categorised as moderately active or active. Furthermore, over 60% of girls fell into very inactive and inactive categories compared to approximately 35% of boys. In phase two both of these percentages increased to 74.0% and 46.1% for girls and boys respectively.

4.1.5 Percentages meeting current activity guidelines

Mean time spent in daily accumulated sustained bouts (of at least five minutes) of moderate to vigorous intensity activity was calculated using the four by one-day recall questionnaire (Cale, 1993). Mean values were then compared with physical activity guidelines for young people (NIH, 1996; HEA, 1998). Percentages and numbers of young people for the overall sample and sub-samples meeting these guidelines for both phase one and phase two of the study are presented in Table 12 in Appendix XIX.

With reference to phase one, almost 60% of the overall sample was found to meet the guideline of 60 minutes of accumulated bouts of activity and a further quarter attaining 30 minutes. However, in phase two the percentage meeting the 60 minutes recommendation had fallen to approximately 50% of the overall sample. Thus, over time fewer participants were meeting the desirable recommendations.

In regard to 'school year', an age related decline in accumulated bouts of moderate to vigorous activity was again observed for both phases one and two. In phase one, two thirds of young people in year A were meeting 60 minutes of accumulated bouts. In year B this fell to almost 60% and of those in year C, only 50% were accumulating 60 minutes of moderate to vigorous physical activity. In addition, a quarter (23.5%) of young people in year C were failing to meet guidelines (either 60 or 30 minute guidelines). This pattern was repeated for phase two, however, with even fewer numbers attaining the recommendations. When participants were one NC Year older, approximately 60% of year A, 50% of year B and 35% of year C pupils were meeting the 60 minutes recommendations.

In phase one over two thirds of white (70.5%), 55.8% of black and 41.1% of Asian pupils achieved at least 60 minutes of accumulated activity. However, a third (32.6%) of young Asians attained 30 minutes of accumulated moderate to vigorous activity, more than black and white ethnic groups. Subsequently, although fewer Asian pupils were meeting the optimal 60 minutes guidelines, a greater percentage than white and black groups were meeting the minimum recommendations. Again, phase two data supported these findings with greater percentages of white than black and Asian groups engaging in accumulated bouts of moderate to vigorous intensity activity of over 60 minutes.

In phase one, the majority of boys (85.8%) were meeting 60 minutes of accumulated bouts of moderate and vigorous activity compared with under half the girls. However, in phase two the percentage of boys meeting this guideline had fallen by approximately 20% to 67.5% and girls' percentages fell by almost 10%. In conclusion, for both phases, approximately three times as many girls than boys were failing to meet recommended guidelines but findings suggest that the percentage drop off rate for boys was greater than for girls.

Although the majority of young people satisfied at least minimum guidelines (i.e. 30 minutes of moderate to vigorous physical activity), and are therefore achieving sufficient levels of activity to maintain health, among certain sub-samples the numbers failing to meet these recommended guidelines are higher than others. Percentages indicate that more year C participants than years A and B, more girls than boys, and more Asian than black and white participants were failing to meet these guidelines. Furthermore, irrespective of age, ethnicity or gender, the percentage of young people failing to meet the minimum guidelines increased as they moved through adolescence.

4.2 Young people's attitudes towards physical education

Attitude towards PE, as measured using the PAAPEQ (Shropshire, 1997), elicited total attitude scores as well as values for each of the five attitude factors (i.e. general interest, assessment, PE teacher, environmental adjustment and organisational choice) for analysis.

Multivariate analysis of variance (MANOVA) with backwards elimination were conducted to assess any differences in attitude towards PE data according to ‘ethnicity’, ‘gender’ and ‘school year’ for both phases of the study.

Results of MANOVA carried out on the data collected during phase one revealed a significant, multivariate, higher order ‘ethnicity’ by ‘gender’ by ‘school year’ interaction ($F_{20,1234} = 1.9$, $p<0.05$). A significant, two way ‘ethnicity’ by ‘gender’ interaction was also found ($F_{10,744} = 1.9$, $p<0.05$). Significant, multivariate main effects were identified according to ‘school year’ ($F_{10,744} = 2.4$, $p<0.01$) and ‘ ethnicity’ ($F_{10,744} = 2.2$, $p<0.05$). Results of multivariate tests are presented in Table 13 in Appendix XX.

In the first factor, general interest (D1) a significant higher order, three-way, ‘ethnicity’ by ‘gender’ by ‘school year’ interaction was revealed ($F_{4,376} = 2.6$, $p<0.05$). Among girls, general interest towards PE became less positive between school years A and C. However, this pattern was not observed for all boys as the attitudes of black males towards PE were found to become more positive in later school years. As a result, black boys went from having one of the least positive attitudes towards the general interest factor in year A to having the most positive in year C. The full nature of the interaction can be seen in Figure 8.

Also within the general interest factor, MANOVA revealed a significant main effect according to ‘school year’ ($F_{2,376} = 8.3$, $p<0.01$). Results of Tukey’s HSD multiple comparisons revealed significant differences in attitude scores between year C and year A (HSD = 4.3, $p<0.01$) and year C and year B (HSD = 3.7, $p<0.01$). Mean values showed that year C respondents have a less positive general interest towards PE than their year A and year B peers (Mean±S.D. were 29.8±4.8, 29.2±4.8 and 25.5±6.2 for years A, B and C respectively). Thus, attitude becomes less positive as pupils progress through secondary education and therefore becomes less favourable with age.

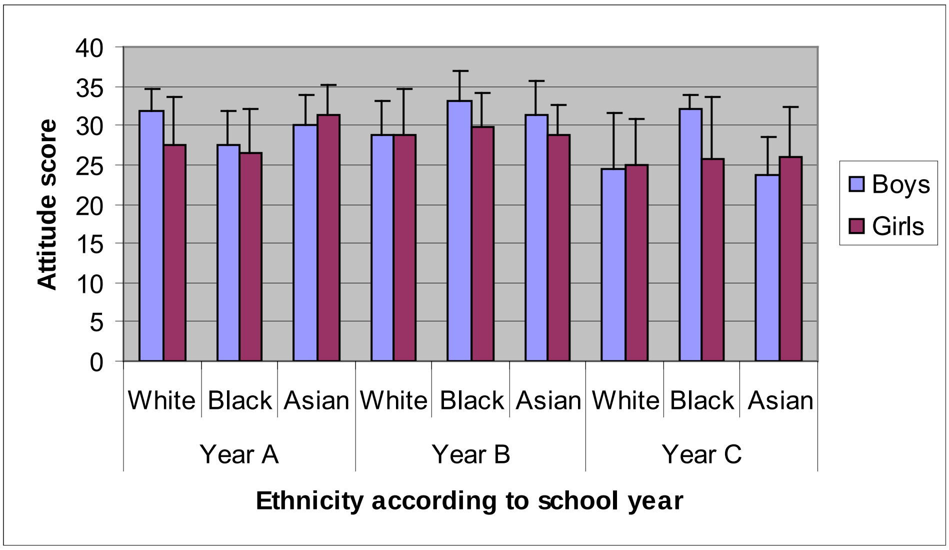

Figure 8. General interest factor 'school year' by 'ethnicity' by 'gender' interaction for phase one.

A significant three-way interaction was revealed within the second factor, assessment in PE (D2) ($F_{4,376} = 2.6$, $p<0.05$). Among girls, attitude towards assessment in PE either declined with school year or remained relatively stable, irrespective of ethnicity. However, for boys, no general pattern was observed and among black boys, attitude towards assessment in PE actually improved and became more positive (see Figure 9).

In the third factor, attitude towards the PE teacher (D3), a significant two-way, ‘ethnicity’ by ‘gender’ interaction was found ($F_{2,376}$ = 3.8, p<0.05). As can be seen from Figure 10, among black and Asian ethnic groups, boys had a less positive attitude towards the PE teacher than girls. However, among white groups this pattern was reversed and it was the boys who had the more favourable attitude towards their teacher.

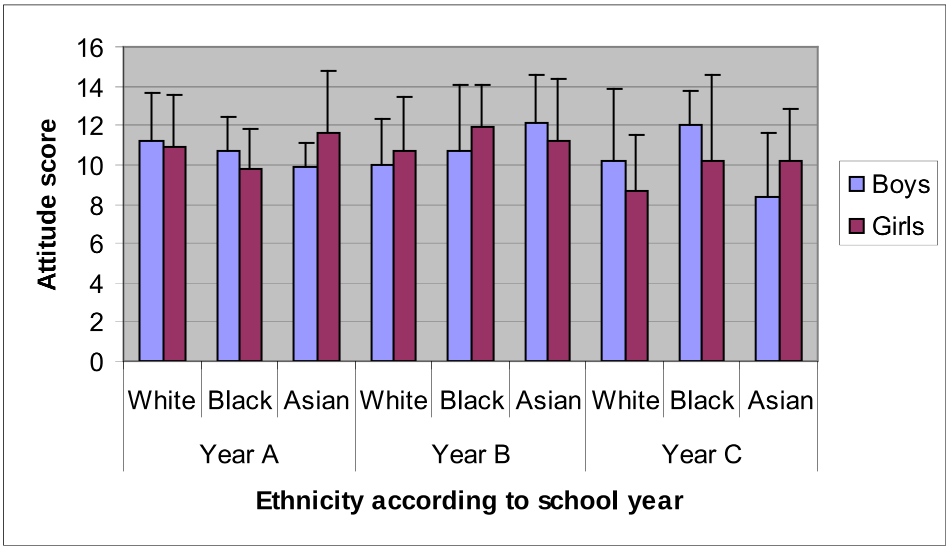

Figure 9. Assessment factor ‘school year’ by ‘ethnicity’ by ‘gender’ interaction for the phase one.

In addition, a significant ‘ethnicity’ main effect was revealed within the PE teacher factor ($F_{2,376}$ = 4.5, p<0.05). Tukey’s post hoc tests identified significant differences between Asian and white pupils (HSD = 1.1, p<0.01). Descriptive statistics showed that in this four-item factor, white pupils responded with a mean score of 12 (±2.3) out of a possible 16. However, the mean score for Asian pupils was 10.8 (±3.0) out of 16. Therefore, Asian pupils had a less favourable attitude towards their PE teachers compared to white pupils. Mean attitude scores for black pupils were between the values for white and Asian groups at 11.3 (±2.3).

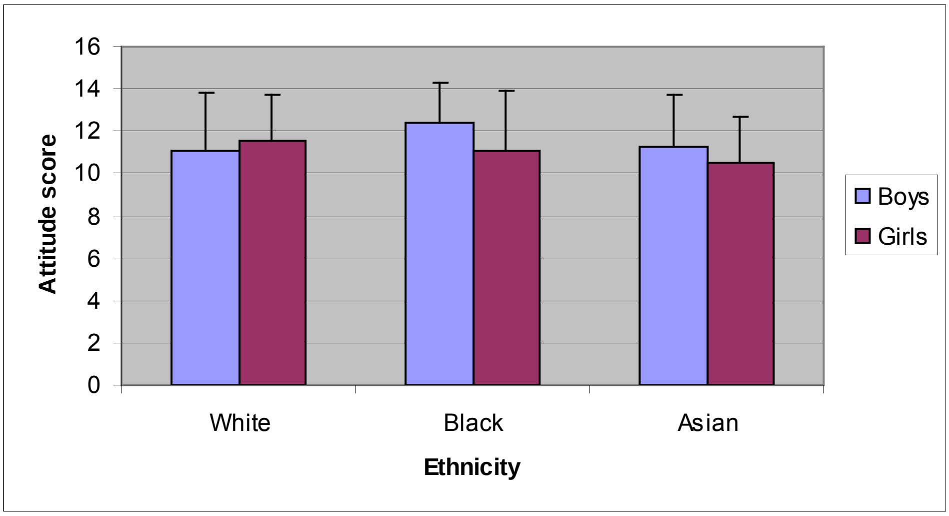

Figure 10. PE teacher factor ‘ethnicity’ by ‘gender’ interaction for phase one

Analysis conducted on the fifth and final factor, organisational choice (D5), again revealed a significant, three-way, ‘ethnicity’ by ‘gender’ by ‘school year’ interaction ($F_{4,376} = 2.6$, $p<0.05$). Across the year groups, boys and girls from white and black ethnic groups were found to have similar attitude scores. However, within the Asian ethnic group, girls in years A and B had more positive attitudes towards the organisational choice factor than boys with Asian boys reporting the lowest attitude scores of all the groups. In year C this finding was reversed and Asian boys reported a more positive attitude towards this factor than either Asian girls or the overall group. Thus, Asian boys went from having the most negative attitude in years A and B to having the most positive in year C. The full nature of the interaction can be seen in Figure 11.

Results of univariate effects for phase one can be seen in Table 15 in Appendix XX.

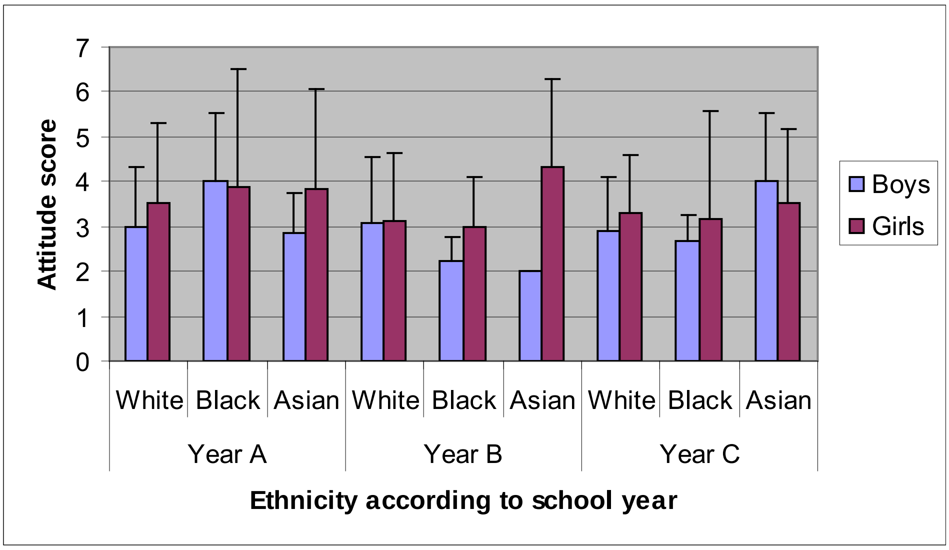

Figure 11. Organisational choice factor 'school year' by 'ethnicity' by 'gender' interaction for phase one

MANOVA conducted on dat a collected during phase two revealed a significant, multivariate, 'ethnicity' by 'gender' interaction ($F_{10,498}$ = 2.7, p<0.01). A significant, multivariate main effect was identified according to 'school year' ($F_{10,498}$ = 2.6, p<0.01). N o further significant multivariate differences were found (p>0.05). Results of multivariate tests are presented in Table 14 in Appendix XX.

In the general interest factor, a significant 'school year' main effect was found ($F_{2,253}$ = 9.6, p<0.01). Results of Tukey's HSD multiple comparisons revealed significant differences in attitude in the general interest factor between participants in year C and those in years A (HSD = 5.4, $p<0.01$) and B (HSD = 3.4, $p<0.01$). Mean attitude score for year C in this interest factor was over three less than year B and over six less than year A (Mean±S.D. were 29.6±4.4, 27.6±6.3 and 24.2±7.8 for years A, B and C respectively). Therefore, the findings supported those of phase one; attitude in this factor becomes less favourable as pupils age.

A similar 'school year' main effect was found in the assessment factor ($F_{2,253}$ = 5.7, $p<0.01$). Tukey's HSD again found significant differences between year C and year A (HSD = 1.8, $p<0.01$) and year C and year B (HSD = 1.4, $p<0.01$). Descriptive statistics showed that pupils' attitudes towards assessment in PE became less positive as they move through secondary school and, therefore, an age related decline was observed (Mean±S.D. were 10.3±2.6, 9.9±2.8 and 8.5±3.3 for Years A, B and C respectively).

As with the findings of phase one, a significant, two-way, 'ethnicity' by 'gender' interaction was found in the PE teacher factor ($F_{2,253}$ = 5.7, $p<0.01$). However, unlike the findings of phase one, the nature of the current interaction showed black and Asian boys to have a more positive attitude than black and Asian girls towards their PE teacher (see Figure 12); the analysis conducted on data collected in phase one found white boys to hold a more favourable attitude than white girls. Thus, between data collections (i.e. between phases one and two) the attitudes of black and Asian boys overtook those of black and Asian girls whilst among the white ethnic group, boys attitudes towards their PE teachers became less favourable than girls.

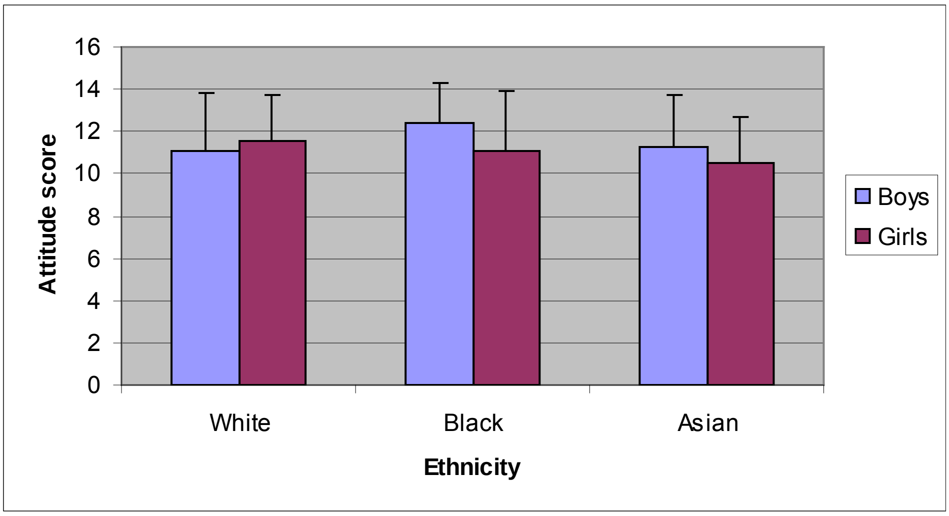

Figure 12. PE teacher factor 'ethnicity' by 'gender' interaction for phase two

Analysis conducted also showed a significant difference in attitude towards the PE teacher according to the main effect of 'school year' ($F_{2,253}$ = 3.2, $p<0.05$). Post hoc tests showed a significant difference in attitude towards the PE teacher between young people in school years B and C (HSD = 1.0, $p<0.05$). Mean values were 11.6 (±2.2) and 10.6 (±2.6) for years B and C respectively. In addition, the mean for year A was similar to the values for year B but showed greater variability in the data (11.5±2.4).

Results of univariate effects for phase two can be seen in Table 16 in Appendix XX.

Means and standard deviations for total attitude towards PE and each of the five factors, during both phases of the study for the whole sample and according to school year, ethnicity and gender can be seen in Table 17 in Appendix XXI.

4.3 Young people's health related fitness

Means and standard deviations for measures of health related fitness (i.e. percent body fat, body mass index, cardiovascular endurance, flexibility, muscular endurance and muscular strength) in a sub-sample of participants for both phases of the study are presented in Table 18. Data were analysed using 3 x 2 x 3 way repeated measures ANOVA with backwards elimination to achieve a parsimonious solution. Between subject factors were 'ethnicity', 'gender' and 'school year'. Where significant differences between subjects were identified, Tukey's HSD post hoc multiple comparisons were conducted to determine where these differences occurred.

4.3.1 Percent body fat and body mass index

Tests of within subject effects revealed a significant difference in percent body fat values between phase one and phase two ($F_{1,53} = 4.4$, $p<0.05$). Mean values indicate that for the whole sample there was a significant increase in body fat from 19.8% to 20.9%. No such difference was observed for body mass index, however, a significant 'time' by 'gender' interaction was revealed ($F_{4,53} = 5.1$, $p<0.05$). Boys' BMI values were found to decrease from 22.5(±7.5) to 18.8(±6.6) between phase one and phase two. For girls, BMI values remained relatively stable between measurements (26.7±7.7 and 26.5±7.4 for phase one and phase two respectively). Within subject effects for 'time' are presented in Tables 19 and 21 (in Appendix XXII) for body fat percent and BMI respectively.

Table 18. Means and standard deviations (M±S.D.) for health related fitness between phases one and two according to school year, ethnicity, and gender.

School Year	Ethnicity	Sex	Body fat (%)		BMI		Cardiovascular Endurance ($ml \cdot kg^{-1} \cdot min^{-1}$)		Flexibility (cm)		Muscular Endurance (No. sit-ups)		Muscular Strength - dominant hand (kg)		Muscular Strength - non-dominant hand (kg)	
			Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two
Overall sample			19.8±3.4	20.9±4.2	25.2±7.8	23.7±8.0	32.7±5.8	33.3±5.5	25.5±8.0	24.7±7.7	18.7±4.2	21.5±4.3	20.9±5.4	23.6±6.0	19.8±5.3	21.8±5.9
Year A			18.9±3.7	20.7±5.2	24.0±8.8	21.7±8.9	32.8±6.9	34.4±6.1	27.2±6.3	25.1±7.8	18.1±3.9	20.8±5.3	17.9±4.2	21.3±5.6	16.8±4.4	20.1±5.8
Year B			19.8±3.3	20.6±3.2	24.9±7.6	23.7±6.6	32.9±5.1	3.1±5.0	24.6±8.9	23.9±7.0	19.2±3.8	21.9±4.0	21.6±5.3	24.0±5.4	20.7±5.0	22.0±4.8
Year C			20.8±3.0	22.3±3.5	27.3±6.7	28.2±7.8	32.3±5.3	31.4±5.1	24.9±8.2	25.6±9.3	18.9±5.1	22.5±2.4	23.6±5.2	27.7±6.0	22.4±5.2	25.3±7.2
	White		19.8±3.1	20.8±3.5	25.6±6.9	24.9±7.0	32.6±5.5	32.9±5.1	25.4±7.5	23.3±7.7	18.4±4.5	21.2±4.4	20.7±5.0	22.4±5.5	19.4±4.8	20.8±5.5
	Black		19.8±3.6	22.7±5.2	22.4±8.5	20.0±9.1	35.1±7.1	36.6±6.8	29.7±7.4	29.1±7.0	20.2±3.0	23.3±4.0	22.0±4.9	26.3±5.6	21.9±5.6	25.4±6.1
	Asian		19.8±4.1	19.6±7.4	26.5±9.0	24.3±8.6	31.4±4.8	31.1±3.7	22.4±8.3	23.6±7.0	18.5±4.1	20.6±4.4	20.5±6.6	24.0±6.7	19.3±5.9	21.1±5.7
		Boys	19.4±3.4	19.7±2.7	22.5±7.5	18.8±6.6	34.3±5.6	36.5±5.1	21.5±7.4	22.5±6.3	21.5±4.5	24.8±2.5	21.6±6.1	25.4±7.0	20.3±5.4	23.6±6.2
		Girls	19.9±3.5	21.6±4.7	26.7±7.7	26.5±7.4	31.9±5.8	31.5±4.9	27.6±7.5	25.9±8.1	17.3±3.2	19.7±4.1	20.5±5.0	22.5±5.1	19.6±5.3	20.8±5.5
Year A	White		19.1±3.7	21.4±4.3	24.4±7.4	25.8±8.7	33.2±7.2	32.8±5.6	25.8±5.9	20.0±7.9	17.9±4.1	20.1±5.7	16.6±3.4	19.2±3.3	15.9±3.5	18.0±4.2
	Black		18.9±2.9	21.9±5.9	22.8±8.9	17.3±6.8	35.8±7.9	39.4±5.4	29.4±7.3	29.7±6.6	20.9±2.8	24.1±3.9	20.8±3.9	24.5±6.0	19.5±4.4	23.9±5.8
	Asian		18.6±4.7	17.9±5.3	24.8±10.5	21.0±9.8	29.4±3.6	30.3±3.3	26.7±5.5	27.1±4.7	15.5±2.8	17.6±4.0	16.4±4.0	20.5±6.9	15.3±4.5	18.7±6.4
		Boys	18.2±3.2	18.8±2.3	20.6±7.7	15.6±5.1	32.8±5.6	36.8±5.6	26.1±5.7	24.2±7.1	20.0±4.4	25.0±3.3	18.2±3.4	22.0±7.0	17.3±3.8	21.4±6.9
		Girls	19.3±4.1	22.0±6.3	26.2±8.8	26.0±8.5	32.8±7.7	32.7±6.1	27.9±6.7	25.7±8.5	16.8±3.1	17.9±4.3	17.6±4.8	20.8±4.7	16.6±4.9	19.3±5.1
Year B	White		19.4±2.9	19.6±2.4	25.3±6.9	23.2±6.0	32.3±4.9	33.4±4.9	25.3±8.1	23.7±6.4	18.8±3.9	21.6±4.1	20.9±4.5	22.3±4.6	19.4±4.3	20.8±4.3
	Black		20.5±4.4	23.9±4.7	21.7±9.5	22.2±11.9	36.4±5.9	34.4±7.9	30.3±8.7	29.3±10.1	19.4±3.1	22.0±4.8	23.8±5.6	29.8±4.1	25.8±4.1	28.2±3.1
	Asian		20.8±3.8	22.0±3.6	26.3±8.2	26.8±4.3	32.1±4.7	30.8±2.8	17.1±7.7	20.8±5.5	20.4±3.9	22.8±3.9	22.0±7.3	27.4±5.7	20.6±5.4	23.2±4.7
		Boys	20.2±3.1	20.7±2.9	22.6±6.5	20.5±6.6	34.4±5.0	36.0±5.1	17.3±7.0	20.6±4.6	21.9±3.7	24.6±2.0	22.0±6.2	27.0±5.5	20.4±4.5	24.2±4.4
		Girls	19.6±3.5	20.5±3.5	26.3±7.9	25.8±5.9	32.1±5.1	31.2±4.0	28.7±7.2	26.2±7.6	17.7±2.8	20.1±4.0	21.3±4.8	21.8±4.3	20.0±5.3	20.4±4.5
Year C	White		20.8±2.8	23.7±3.7	27.1±6.5	29.2±5.6	32.5±5.3	31.4±5.6	25.3±7.9	29.2±9.8	18.1±5.7	22.0±2.2	23.3±4.7	28.5±7.2	22.0±5.0	26.2±7.9
	Black		21.7±4.5	23.7±3.3	22.7±4.7	27.4±13.4	27.7±1.6	28.5±2.4	29.0±5.6	26.0±2.8	18.7±3.1	22.0±4.2	22.3±7.4	29.3±3.1	21.2±9.2	27.8±11.7
	Asian		20.3±3.3	19.5±2.0	29.5±7.4	27.1±10.4	33.5±5.9	32.8±5.6	22.3±9.6	21.0±10.4	20.8±3.5	23.3±2.2	25.0±5.9	25.7±5.9	23.8±4.6	22.9±5.2
		Boys	20.1±4.2	18.4±1.7	25.9±8.6	27.1±3.7	36.9±6.4	37.4±4.4	22.0±6.3	24.0±11.3	23.6±5.7	24.5±0.7	27.2±6.2	34.2±5.7	26.2±5.4	31.6±7.2
		Girls	21.0±2.5	23.1±3.3	27.8±6.0	28.4±8.5	30.7±3.9	30.2±4.4	25.9±8.6	26.0±9.6	17.2±3.7	22.0±2.4	22.4±4.2	26.4±5.4	21.1±4.4	24.1±6.8

In terms of percent body fat, tests of between subject effects revealed a significant 'school year' by 'ethnicity' interaction ($F_{4,53} = 2.6$, $p<0.05$) (see Figure 13). Findings indicated that amongst black pupils, percent body fat for year B was greater than year A but years B and C had similar levels of body fat percent (23.9% and 23.7% for years B and C respectively). However, amongst Asian and white groups, more complex patterns were observed. The percent body fat of Asian participants increased between years A and B to 22%, before declining to 19.5% in year C. Conversely, among white participants, body fat values decreased between from 21.4% in year A to 19.6% in year B before increasing in year C to percent values similar to those of black pupils (i.e. 23.7%). Furthermore, a significant 'gender' main effect was found ($F_{1,53} = 16.4$, $p<0.01$). In phase two, mean percent body fat values for girls were 2% above those of boys. A similar trend was observed in phase one although the difference was not as marked (i.e. a body fat difference of 0.5%). Results from between subject effects can be seen in Table 20 (Appendix XXII).

Tests of between subject effects revealed a significant 'school year' by 'ethnicity' interaction ($F_{4,53} = 3.1$, $p<0.05$) according to BMI (see Figure 14) and partially replicates the pattern observed for the interaction according to percent body fat. BMI values for black pupils again followed an age related increase between years A and C (mean values for black groups were 17.3, 22.2 and 27.4 for years A, B and C respectively). A similar pattern was observed for Asian pupils although the increase was less gradual than for black participants (mean values for Asian groups were 21.0, 26.8 and 27.1 for years A, B and C respectively). However, BMI values for white pupils again decreased between years A and B, from 25.8 to 23.2, before increasing again to 29.2. Thus, in years A and C white pupils have the highest BMI values. Results of between subject effects can be seen in Table 22 (Appendix XXII).

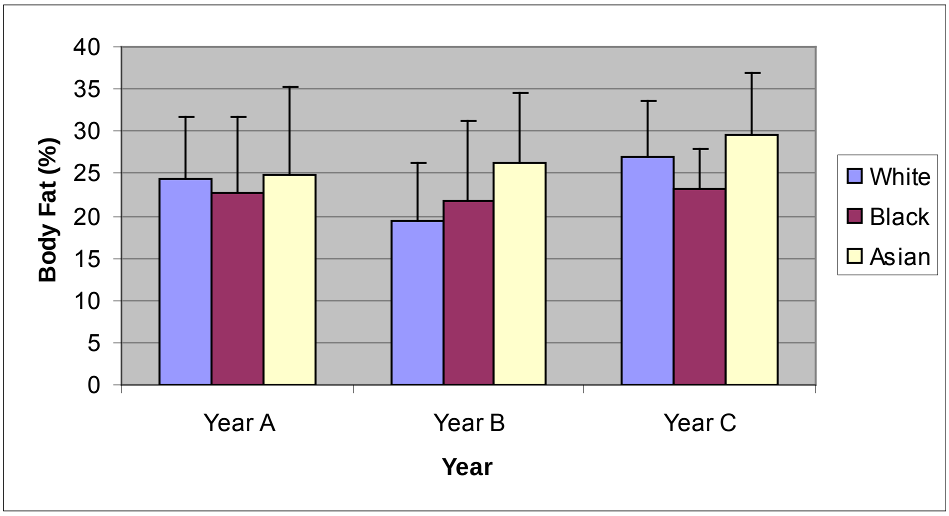

Figure 13. 'School year' by 'ethnicity' interaction according to percent body fat

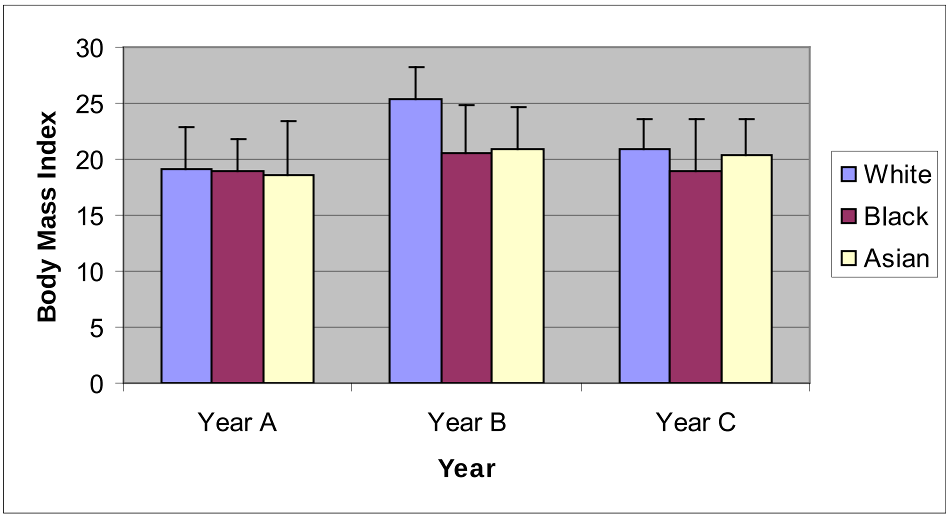

Figure14. 'School year' by 'ethnicity' interaction according to BMI

4.3.2 Cardiovascular endurance

Tests of within subject effects did not reveal any significant differences (all $p>0.05$). Results from within subject effects can be seen in Table 23 (Appendix XXII).

Tests of between subject effects identified a significant 'school year' by 'ethnicity' interaction ($F_{4,53} = 2.7$, $p<0.05$) (see Figure 15). An age related increase in predicted VO_2 peak levels was revealed for white and Asian participants. However, young black people, who achieved the highest values in year A, demonstrated a decrease in cardiovascular fitness with school year (i.e. cardiovascular endurance declines with school year). Furthermore, a significant main effect according to 'gender' ($F_{1,53} = 10.4$, $p<0.01$) was found. Mean values indicated that boys possess a greater level of cardiovascular endurance compared to girls. Mean (±S.D.) values for phase two were 36.5 (±5.1) $ml \cdot kg^{-1} \cdot min^{-1}$ and 31.5 (±4.9) $ml \cdot kg^{-1} \cdot min^{-1}$ for boys and girls respectively. Results from between subject effects can be seen in Table 24 (Appendix XXII).

4.3.3 Flexibility

Repeated measures ANOVA did not reveal any significant within subject differences (all $p>0.05$) in hamstring and lower back flexibility levels. Results from within subject effects can be seen in Table 25 (Appendix XXII).

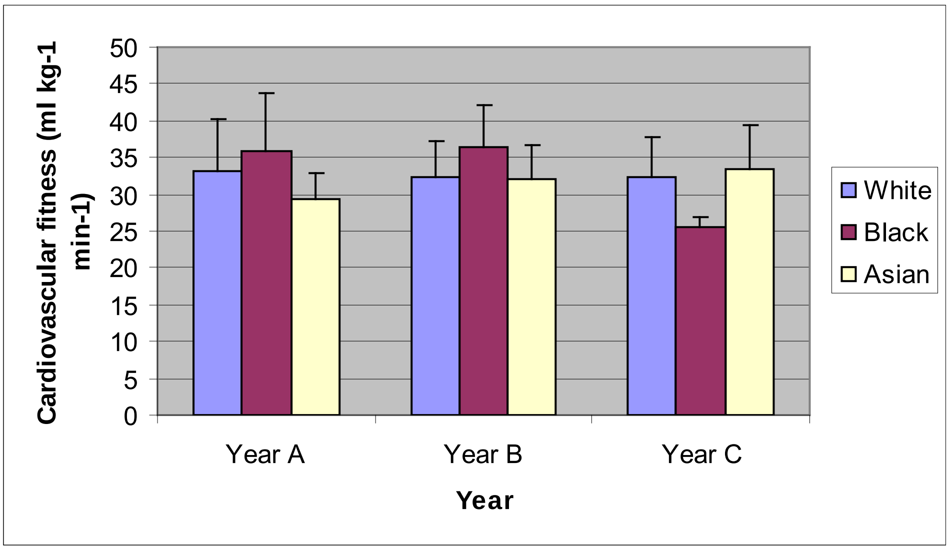

Figure 15. 'School year' by 'ethnicity' interaction according to cardiovascular fitness

Tests of between subject effects identified a significant main effect according to 'ethnicity' ($F_{2,56}$ = 3.8, $p<0.05$). Tukey's HSD multiple comparisons revealed significant differences between black and white (HSD = 6.1, $p<0.01$) and between black and Asian participants (HSD = 5.9, $p<0.05$). Mean (±S.D) values for the sit and reach test for black pupils were 29.1 (±7.0) cm compared to 23.3 (±7.7) cm and 23.6 (±7.0) cm for white and Asian groups respectively. Therefore, black participants had a higher mean flexibility than white and Asian groups who were found to possess a level of flexibility similar to each other. Results from between subject effects can be seen in Table 26 (Appendix XXII).

4.3.4 Muscular endurance

Tests of within subject effects revealed a significant difference in the number of sit-ups completed in thirty seconds between phases one and two of the study ($F_{1,56}$ = 25.7, p<0.01). Mean (±S.D.) values indicated that the number of sit-ups completed increased between phases one and two from 18.7 (±4.2) to 21.5 (±4.3). Results from within subject effects can be seen in Table 27 (Appendix XXII).

Tests of between subject effects identified significant main effects according to ‘school year’ ($F_{2,56}$ = 5.6, p<0.01), ‘ethnicity’ ($F_{2,56}$ = 3.9, p<0.05) and ‘gender’ ($F_{1,56}$ = 50.8, p<0.01). With reference to ethnic differences, Tukey’s HSD multiple comparisons indicated significant differences between black and white (HSD = 2.0, p<0.05) and black and Asian groups (HSD = 2.8, p<0.01). Mean values indicated that black pupils completed approximately two more sit-ups than both white and Asian pupils. Tukey’s HSD multiple comparisons were again used to explore differences according to school year and significant differences were revealed between participants in year A and year B (HSD = 1.5, p<0.05). Descriptive statistics showed that on average, Year A pupils completed approximately one less sit-up than those in Year B. With reference to gender, mean (±S.D.) values showed that boys completed 24.8 (±2.5) sit-ups compared with 19.7 (±4.1) completed by girls; a difference of almost five sit-ups in thirty seconds. Results from between subject effects can be seen in Table 28 (Appendix XXII).

4.3.5 Muscular strength

Tests of within subject effects revealed significant differences between phases one and two in the grip strengths of dominant ($F_{1,55}$ = 34.6, p<0.01) and non-dominant hands ($F_{1,55}$ = 25.1, p<0.01). Mean (±S.D.) values showed that in both instances performance increased; for the dominant hand, grip strength increased from 20.9 (±5.4) kg to 23.6 (±6.0) kg and for the non-dominant hand values increased from 19.8 (±5.3) kg to 21.8 (±5.9) kg. Results from within subject effects can be seen in Tables 29 and 31 (Appendix XXII) for dominant and non-dominant hands respectively.

With reference to the dominant hand, tests of between subject effects identified significant main effects according to 'school year' ($F_{2,55}$ = 11.3, $p<0.01$) and 'gender' ($F_{1,55}$ = 5.9, $p<0.05$). Tukey's HSD multiple comparisons revealed significant differences between participants in years A and B (HSD = 3.2, $p<0.05$) and between young people in years A and C (HSD = 6.3, $p<0.01$). Descriptive statistics showed that mean values in year A were approximately 3 kg less than values for year B and in excess of 6 kg less than year C. Mean values showed boys to posses greater grip strength than girls (Mean±S.D. were 25.4±7.0 and 22.5±5.1 kg for boys and girls respectively). Results from between subject effects can be seen in Table 30 (Appendix XXII).

In terms of the non-dominant hand, tests of between subject effects identified significant main effects according to 'school year' ($F_{2,55}$ = 9.7, $p<0.01$), 'ethnicity' ($F_{2,55}$ = 4.6, $p<0.05$) and 'gender' ($F_{1,55}$ = 4.2, $p<0.05$). Tukey's HSD identified a significant difference between year A and year C (HSD = 5.7, $p<0.01$). Descriptive statistics showed a school year related increase in grip strengths of the non-dominant hand; mean values increased by almost 2 kg between years A and B and by a further 3.3 kg between years B and C.

Tukey's HSD multiple comparisons was again used and revealed significant differences between black and Asian groups (HSD = 3.6, $p<0.05$). Black pupils had a mean (±S.D.) strength of 25.4 (±6.1) kg, approximately 4 kg more than Asian pupils. Boys were again found to have a greater level of muscular strength; on average 2.6 kg stronger than girls. Results from between subject effects can be seen in Table 32 (Appendix XXII).

4.4 Relationship between attitude towards physical education and physical activity

Pearson's product moment correlations were applied to data collected during both phases of the study to determine the significance of relationships between young people's physical activity and attitude towards physical education. P hysical activity variables incorporate average daily energy expenditure (kcal kg^{-1} day^{-1}), time spent in moderate intensity physical activity (min.) and time spent in vigorous intensity physical activity (min.). A ttitude values comprise total attitude scores and attitude towards each of the five factors (i.e. general interest, assessment, PE teacher, environmental adjustment and organisational choice).

The results of analysis carried out on data collected during phase one indicated weak yet significant positive relationships between total attitude towards PE and energy expenditure ($r = .16$, $p<0.01$), time spent in moderate activity ($r = .12$, $p<0.05$) and time spent in vigorous activity ($r = .18$, $p<0.01$), thereby indicating that those individuals who hold a more positive total attitude towards PE are more physically active and engage in activities with a higher energy cost and of longer duration. Alternatively, more active individuals have a more positive attitude towards the subject. Weak yet significant positive relationships were also found in the general interest factor. This factor, comprising nine items, revealed similar correlations to those listed above: average daily energy expenditure ($r = .18$, $p<0.01$), time spent in moderate activity ($r = .13$, $p<0.01$) and vigorous activity ($r = .20$, $p<0.01$). These findings would suggest that young people who hold a more positive general interest towards the subject (e.g. wanting more PE lessons, thinking PE is fun) expend greater levels of energy by participating in activities of at least moderate intensity.

Significant, yet weak, positive relationships were also revealed between other PAAPEQ factors and physical activity variables. The assessment factor correlated with moderate activity ($r = .19$, $p<0.05$). Young people who responded more positively to assessment in PE spent more time in moderate activity. Also, young people who held more favourable attitudes towards their PE teachers had higher average daily energy expenditure ($r = .12$, $p<0.05$) and engaged in more vigorous activity ($r = .16$, $p<0.01$). This relationship would suggest that higher intensity activities such as invasion games (e.g. basketball, football, dance and jogging/running), typical school sports/activities, are more popular amongst young people who hold a positive attitude towards their teacher. Similarly, those with greater levels of average daily energy expenditure who also hold positive attitudes towards their teacher(s) are more likely to take part in vigorous activities like those on offer at school. Correlation coefficients for the relationships between physical activity and attitude towards PE in phase one are presented in Table 33 (Appendix XXIII).

With reference to the results of analysis carried out on phase two data, similar weak yet significant positive relationships were observed between total attitude towards PE and average daily energy expenditure ($r = .14$, $p<0.05$) and time spent in vigorous activity ($r = .23$, $p<0.01$), thus, indicating that young people who are more physically active and engage in activities of longer duration, hold a more positive total attitude towards PE. However, unlike the findings of analyses conducted in phase one, no significant relationship was revealed between total attitude towards PE and moderate activity. This suggests that as young people move through adolescence, a positive attitude towards PE is more dependent upon participation in vigorous as opposed to moderate activity. Additionally, significant positive relationships were again found between the general interest factor and average daily energy expenditure ($r = .23$, $p<0.01$), time spent in moderate ($r = .15$, $p<0.05$) and vigorous activity ($r = .28$, $p<0.01$).

In phase two, significant positive relationships were also revealed between vigorous activity and assessment in PE ($r = .14$, $p<0.05$) and environmental adjustment ($r = .15$, $p<0.05$) factors. Therefore, young people who spend less time in vigorous activity hold less positive attitudes towards assessment in PE and environmental factors such as PE kit. Furthermore, a significant negative relationship was found between the organisational choice factor and average daily energy expenditure ($r = -.15$, $p<0.05$). This indicates that young people who expend more energy would like a greater degree of choice in how PE is organised. C orrelation coefficients for the relationships between physical activity and attitude towards PE are presented in Table 34 (Appendix XXIII).

4.5 Relationship between health related fitness and physical activity

Pearson's product moment correlations were applied in both phases of the study to determine the nature of any relationships between each of the physical fitness variables (i.e. percent body fat, body mass index, cardiovascular endurance, flexibility, muscular endurance and muscular strength) and young people's average daily energy expenditure (kcal kg^{-1} day^{-1}), time spent in moderate intensity physical activity (min.) and time spent in vigorous intensity physical activity (min.).

Results from phase one indicated weak yet significant positive relationships between cardiovascular endurance and average daily energy expenditure ($r = .21$, $p<0.05$) and time spent in vigorous activity ($r = .20$, $p<0.05$). However, cardiovascular endurance was not found to be significantly related to the amount of time spent in moderate activity. These findings would indicate that young people who engage in activities with greater energy costs, such as invasion games and jogging/running, are more likely to have higher levels of cardiovascular fitness due to the physiological demands of such sports/activities.

Significant positive relationships were also revealed between muscular endurance, as measured using the maximum amount of sit-ups completed in thirty seconds, and average daily energy expenditure ($r = .28$, $p<0.01$) and time spent in moderate ($r = .17$, $p<0.05$) and vigorous activity ($r = .20$, $p<0.05$). These relationships can be due to the fact that young people who have higher physical activity levels engage in physically active pursuits, of both moderate and vigorous intensity, which require greater abdominal muscular endurance. Correlation coefficients for the relationships between physical activity and physical fitness variables are presented in Table 35 (Appendix XXIV).

With reference to data collected during phase two, results indicated a weak yet significant negative relationship between percent body fat and time spent in vigorous activity ($r = -.26$, $p<0.05$). Therefore, young people who possess less body fat are more vigorously active. Significant positive relationships between muscular endurance and average daily energy expenditure ($r = .32$, $p<0.01$) and vigorous activity ($r = .33$, $p<0.01$) were also revealed. Thus, pupils who are more active and engage in activity with a higher energy cost completed more sit-ups. Correlation coefficients for the relationships between physical activity and physical fitness variables are presented in Table 36 (Appendix XXIV).

4.6 Summary of findings

The following section and accompanying tables provide a summary of significant findings for each of the following: physical activity, attitude towards PE, health related fitness, relationship between physical activity and attitude towards PE, and relationship between physical activity and health related fitness.

The findings of the analyses conducted on physical activity data are summarised in Table 37. Significant time by ethnicity by gender, time by ethnicity, time by days by school year, time by days, and days by school year interactions were found for energy expenditure data. Energy expenditure, moderate and vigorous activity decreased between phase one and phase two. Moderate and vigorous activity differed according to school year, ethnicity and gender whereas energy expenditure differed according to ethnicity and gender.

The findings of the analysis conducted on attitude data are summarised in Table 38. Significant school year by ethnicity by gender interactions were found for total attitude towards PE as well as general interest, assessment, PE teacher and organisational choice factors, and significant ethnicity by gender interactions were found for total attitude and PE teacher factors. Total attitude and general interest became less favourable the older school pupils became, and attitudes towards the PE teacher differed according to ethnicity.

Table 37. Summary of significant differences found in energy expenditure (kcal kg^{-1} day^{-1}), and time spent in moderate and vigorous activity (min.) according to ethnicity, school year and gender (and their interactions).

	Energy expenditure	Moderate activity	Vigorous activity
Interactions			
Time x ethnicity x gender	√	n/a	n/a
Time x ethnicity	√	n/a	n/a
Time x days x school year	√	n/a	n/a
Time x days	√	n/a	n/a
Days x school year	√	n/a	n/a
Main effects			
Time	√	√	√
Days	√	n/a	n/a
School year	X	√	√
Ethnicity	√	√	√
Gender	√	√	√

Table 38. Summary of significant differences found in attitude towards physical education in each of the five attitude factors: general interest (GI), assessment (A), PE teacher (T), environmental adjustment (EA) and organisational choice (OC); according to ethnicity, school year and g ender (and their interactions).

	GI	A	T	EA	OC	Total
Interactions						
School year x ethnicity x gender	√	√	√	X	√	√
Ethnicity x gender	X	X	√	X	X	√
Main effects						
School year	√	X	X	X	X	√
Ethnicity	X	X	√	X	X	√
Gender	X	X	X	X	X	X

The findings of the analysis conducted on health-related fitness data are summarised in Table 39. A significant time by ethnicity interaction was found for BMI, and significant school year by ethnicity interactions were found for percent body fat, BMI and cardiovascular fitness. Percent body fat, muscular endurance and muscular strength all increased between phase one and phase two. Muscular endurance and muscular strength also increased with school year. Ethnic differences were found for flexibility, muscular endurance, and muscular strength, and gender differences were found for percent body fat, cardiovascular endurance, muscular endurance, and muscular strength.

Table 39. Summary of significant differences found in the health related fitness variables of body fatness (%BF and BMI), cardiovascular endurance (CV), flexibility (F), muscular endurance (ME) and muscular strength (MS) according to ethnicity, school year and gender (and their interactions).

	%BF	BMI	CV	F	ME	MS
Interactions						
Time x gender	X	√	X	X	X	X
School year x ethnicity	√	√	√	X	X	X
Main effects						
Time	√	X	X	X	√	√
School year	X	X	X	X	√	√
Ethnicity	X	X	X	√	√	√
Gender	√	X	√	X	√	√

Relationships between attitude towards PE and physical activity are presented in Table 40. For both phases, positive relationships were found between the general interest attitude towards PE factor and energy expenditure, moderate activity, and vigorous activity. Attitude towards assessment in PE was related to moderate activity in phase one and vigorous activity in phase two. In phase one, attitude towards the PE teacher was related to energy expenditure and vigorous activity. In phase two, environmental adjustment was related to vigorous activity and organisational choice was significantly related to energy expenditure. In both phases, positive relationships were found between total attitude towards PE and energy expenditure, and vigorous activity. In phase one a relationship between total attitude and moderate activity was also found.

Table 40. Summary of significant relationships between physical activity variables and attitude towards physical education in phases one and two.

	Energy expenditure	Moderate activity	Vigorous activity
Phase one			
General interest	√	√	√
Assessment	X	√	X
PE teacher	√	X	√
Total attitude	√	√	√
Phase two			
General interest	√	√	√
Assessment	X	X	√
Environmental adjustment	X	X	√
Organisational choice	√	X	X
Total attitude	√	X	√

Relationships between health-related fitness and physical activity variables are summarised in Table 41. In phase one, cardiovascular endurance was related to energy expenditure and vigorous activity, and in phase two, percent body fat was related to vigorous activity. In both phase one and phase two of the study muscular endurance was related to energy expenditure and vigorous activity. In phase one a relationship between muscular endurance and moderate activity was also found.

Table 41. Summary of significant relationships between physical activity variables and health related fitness variables in phases one and two.

	Energy expenditure	Moderate activity	Vigorous activity
Phase one			
Cardiovascular endurance	√	X	√
Muscular endurance	√	√	√
Phase two			
Percent body fat	X	X	√
Muscular endurance	√	X	√

5.0 DISCUSSION

5.1 Young people's physical activity

The present study's findings into young people's physical activity according to the independent variables of ethnicity, gender and school year will be discussed in terms of the following: levels of daily energy expenditure, time spent in moderate and vigorous activity, physical activity status and percentages of young people meeting current physical activity guidelines.

5.1.1 Physical activity across the week

The findings of the current study indicate that young people's average daily energy expenditure differs significantly across the week with energy expenditure at its highest on Saturdays (38 kcal kg^{-1} day^{-1}) and declining slightly on Sundays to a level similar to that of weekdays (approximately 2 to 2.5 kcal kg^{-1} day^{-1} less than on Saturdays). Energy expenditure was found to be at its lowest during weekdays, remaining relatively stable with no significant differences between weekdays for both phases of the study (both $p>0.05$). Therefore, as energy expenditure remained stable during school days, school commitments occupy much of young people's time and inhibits activity levels. Furthermore, it can be suggested that it is leisure time activity that is responsible for increasing young people's energy expenditure.

It is important to consider that previous physical activity research using the four by one-day recall questionnaire as a method for data collection has tended to provide average daily energy expenditure without differentiating between the days of the week, therefore, making comparisons between the findings of the present study and those previously reported in the literature problematic. Nevertheless, the findings of the present study are consistent with those of Pate et al. (1994) and Simons-Morton et al. (1990) suggesting that young people and adolescents are significantly more active during out of school hours which includes Saturdays and Sundays. However, the present study made no distinction between physical activity levels before and after school and activity during the school day. Therefore, the study has not established whether weekday activity was at a similar level during out of school hours to weekend activity. Due to the fact that Saturdays and Sundays are generally less structured than school days, there may be a tendency for young respondents to over-estimate the intensity and duration of their activity and differences can in part be due to the respondents' ability to accurately recall activity. However, this does not explain the difference between higher activity levels during Saturdays compared with Sundays.

One explanation for suppressed levels of activity during weekdays is the time restrictions placed upon PE in school timetables. This notion has previously been reported in the literature and attributed to an increased emphasis placed upon the improvement of standards in literacy and numeracy (Speednet, 1999). It can also be suggested that much of the school day fails to provide pupils with sufficient opportunity to be active either during PE lessons or breaktimes; particularly opportunities to engage in sport and moderate to high intensity activities. However, the work of Ridgers, Stratton and Fairclough (2004) indicated that breaktimes can contribute to the physical activity levels of younger, primary school aged pupils although the amount of time spent in moderate, high and very high intensity activity was found to differ between boys and girls. Therefore, as the current study found differences between schoolday and weekday activity levels, it can be suggested that school breaktimes do not contribute to the physical activity levels of older, secondary school aged pupils and this may be due to pupil choice or indeed due to human and/or physical resources at participant secondary schools. Indeed, it has been reported that a number of factors affect children's (4-12 years) physical activity during school breaktimes (Ridgers, Stratton and Fairclough, 2006). In their review of school-based interventions to increase physical activity, Ridgers and colleagues identified gender, age, playground space and equipment as just some of the factors and advocated that more work was needed to explore the impact of such factors on physical activity among young people.

Another explanation for lower levels of energy expenditure during school days is provided by the ever increasing numbers of young people travelling to school by car or public transport. As a consequence fewer pupils have the opportunity to increase activity levels through active transport (e.g. cycling or walking to school). Over recent times, the increased prevalence of motorised transport (i.e. cars, public transport) is partially responsible for this trend, however, the perceived notion that our streets are unsafe for young people has also been identified as a cause for a decline in independent mobility amongst the young (Hillman, 1993). School pupils who walk to and from school for approximately twenty minutes every day increase their average daily energy expenditure by over 1.5 kcal kg^{-1} day^{-1} thus highlighting the positive effect active transport can have upon the physical activity levels of young people. It is important to note that previous research using heart rate data has reported findings to the contrary and indicated that young people are most active during weekdays. Welsman and Armstrong (2000) suggested that full-time education is the main reason for maintaining young people's physical activity at a higher level during the week than at weekends. Furthermore, Sleap and Warburton (1996; 1992) reported that adolescents were less likely to engage in higher intensity activity during their time at home due to the passive leisure time activities available to them (e.g. television watching, computers). Indeed, it has previously been suggested that school-based physical activity interventions have failed to evidence an overall increase in physical activity due to compensation by increasing sedentary activity during out-of-school hours (Zahner et al., 2006). Participants in the current study are demonstrating the opposite trend and expend more energy at weekends and less during school days. Therefore, young people in the current study spend more of their out of school time during the school week in lower intensity activities, such as completing homework and travelling to and from school, whereas at weekends, especially Saturdays, they compensate for this by spending the greater amount of leisure time available to them engaging in activities of a higher energy cost including sport, housework and, particularly in the case of older pupils, part-time employment.

More research is required in the area to establish whether young people are generally more active on school days or free days (i.e. weekdays and weekends). As the findings of the current study and research previously conducted fail to agree on the physical activity habits of young people on different days of the week it is important to consider the method(s) used to measure activity in young people. For future studies, researchers should consider using a combination of measures of physical activity, incorporating both quantitative and qualitative measures, to build a clearer picture of the activity habits of young people throughout the week and this type of approach has previously been advocated (Telford et al., 2004; Treuth, 2002; Armstrong and Welsman, 1997). Data obtained from such research can be used to inform any future exercise promotion or intervention to encourage young people to become more active and to establish whether school-based or community based initiatives would be more effective in increasing activity. However, such studies are costly both in terms of the time and financial expense as well as placing higher demands on participants and the schools they attend. Therefore, it was not practical to adopt such a methodology in the current study.

5.1.1.1 'Days' by 'school year' interaction

As previously discussed physical activity levels remained stable during the school weak. However, energy expenditure across the different days of the week also varied according to school year with results indicating that NC Year 8 pupils were most active on school days. This difference was found cross-sectionally (with year B expending 1-2 kcal kg^{-1} day^{-1} more on school days than years A and C in phase one of the study) and longitudinally (between phases one and two, energy expenditure of year A increased by approximately 1 kcal kg^{-1} day^{-1} for school days). Results suggest that although physical activity during school days generally declines post entry to secondary school, during NC Year 8 (between the ages of 12 and 13 years) there is a temporary rise in physical activity. Although, conducted with different year groups (i.e. NC Years 6 and 7), a similar age related increase in physical activity was observed by Carroll and Shropshire (1999), however, this increase was not specifically identified during school days but generally. The findings of the current study and the previous work of Carroll and Shropshire (1999) suggest that physical activity levels during school increase during the first two years of secondary education (NC Years 7 and 8) following the transfer from primary education (NC Year 6) to secondary. Therefore, pupils' activity levels throughout this transition period warrants further investigation.

A less complex pattern was observed during weekends; physical activity levels followed a significant age related decline with young people becoming less active as they move through secondary school. For example, on Saturdays during phase one of the study, year A (NC Year 7) pupils expended more energy than pupils in year B (NC Year 8) who in turn expended more energy than those in year C (NC Year 9) (mean energy expenditure values were 43, 41 and 39 kcal kg^{-1} day^{-1} for Years 7, 8 and 9 respectively). This pattern supports previous suggestions that pre-teenagers are the most physically active segment of the population (Sallis et al., 1998) and that activity declines with age (Hovell et al., 1999). Findings can be explained in terms of the increased academic demands placed upon older pupils by the education system. As British secondary school children approach the end of Key Stage 3 (NC Year 9) and throughout Key Stage 4 (NC Years 10 and 11) academic workload increases in preparation for national pupil assessments (i.e. NC Year 9 SATs, GCSEs and vocational equivalents). As a result, older pupils will have increasing homework and out of school study to complete over weekends and thus less time to engage in physical intensity activity. Similarly, many older pupils spend some of their weekends in part-time paid employment whereas younger pupils, perhaps too young to work, have more free time available to them. Older pupils also have greater domestic responsibilities (e.g. household chores, caring for younger siblings) than younger pupils.

5.1.2 Age related changes in physical activity

The current study looked for differences cross-sectionally (between groups of pupils from different school years) and longitudinally (between phase one and phase two). Young people's mean energy expenditure fell significantly, irrespective of ethnicity, gender or school year. These findings support those of previous research (e.g. Hovell et al., 1999; Harris, 1998; Pate et al., 1994). Indeed, the work of Hovell and colleagues (1999) which, like the current study, used self-report methods of physical activity, identified an age related decline in energy expenditure. Conversely, previous research conducted amongst British school children using self-report questionnaires found that physical activity actually increased with age (Carroll and Shropshire, 1999). It is, however, important to note that the study conducted by Carroll and Shropshire (1999) looked at the activity levels of NC Year 6 (last year of Primary School) and NC Year 7 (first year of Secondary School) whereas the present study focussed on secondary school year groups. These conflicting findings suggest that when children move into secondary school there is a temporary rise in activity levels. This rise may be due to a wider range of extra curricular activities available to pupils and specialist PE delivery. However, findings suggest that as pupils move into subsequent secondary school years, their activity levels generally decrease.

To support the findings of the analysis conducted on energy expenditure data, statistically significant longitudinal differences were revealed in the amount of time spent in both moderate and vigorous activity. Thus, between phases one and two, time spent in MVPA per day decreased. Previous research has suggested that for children to accrue health benefits some activity is better than none and that it does not matter whether MVPA is continuous (Pate, 1995; Sleap and Warburton, 1994). For this reason, the present study has accumulated short bouts (minimum of five minutes) throughout the day. This is supported by the observation that children's physical activity patterns are different from those of adults (Welk et al., 2000; Armstrong and Welsman, 1997; Pangrazi et al, 1997) in that activity is intermittent and children do not tend to raise their heart rate for a sustained period of time. However, given that the participants in this study were pre-adolescent or in early adolescence (i.e. 11-14 years in phase one and 12-15 years in phase two), they will be at different stages of maturation dependent upon the stage of puberty. Therefore, considerable variability exists in the nature of the activities participated in or indeed whether activity was intermittent or continuous. For example, two individuals can spend the same amount of time in moderate activity but for different frequencies; one participant for a single sustained period of 30 minutes, another for three, 10 minute bouts at different points in the day. Subsequently, adult recommendations are more appropriate for certain individuals due to maturational (anatomical, physiological and psychological) differences between pupils in the same school year group. Differences can also be exacerbated by differences in chronological age. For example a pupil in NC Year 9 may only be a few days younger than some Year 10 pupils (14 years of age for the majority of the academic year), or a little older than Year 8 pupils (13 years of age for the majority of the academic year). Therefore, future work should establish growth and maturation of individual participants. However, it is reasonable to consider that in terms of state education, children are organised according to NC year groups without consideration for the growth and maturation of individual pupils and subsequently young people in the same year group receive the same, or at least a very similar, timetable and are provided with the same school based opportunities for physical activity.

Physical activity status data revealed similar differences between the two phases of the study. The percentage of the overall sample categorised as very active decreased between phase one and phase two. In addition, the percentage categorised as either very inactive or inactive increased between the two measurements. In addition, percentages failing to meet either 60 minute (NIH, 1996; HEA 1998) or 30 minute (HEA, 1998) recommendations increased between from phase one to phase two. These findings support previous work which has revealed that physical activity follows a downward trend during adolescence (Biddle et al., 2004; Pate et al., 1994; Mahoney, 1995).

Although it has not been the remit of the current study to provide information on the reasons why physical activity levels decline as young people age, a number of explanations can be proposed. As previously discussed, this trend could be due to increased responsibility and commitments, such as duties around the home, increasing amounts of homework and increased frequency of part-time employment, which all impact upon the amount of leisure time available to young people. Furthermore, with increasing technology comes increasing opportunity to engage in sedentary leisure time pursuits (e.g. watching television, use of computers, playing computerised games stations). Research conducted in the U.S. and U.K. has found that on average young people watch in excess of four hours of television per day (Marshall et al, 2002). This results in increased periods of inactivity. In addition, as young people move through adolescence they gain greater financial independence and choose to spend their time and money on physically passive activities as opposed to active leisure pursuits which are also available to them. Professionals concerned with promoting physical activity and exercise in young people need to establish the reasons for and practical barriers to participation so that opportunities for activity are developed for this age range. As previous work has established that multiple factors impact upon health and health related behaviours (Novak, Ahlgren and Hammerström, 2006), more research that takes a life course approach is required to establish the physical and social exposures which can have an impact upon activity levels in adolescence.

The present study has found activity levels to decline amongst young people of secondary school age it is unclear whether the activity levels of participants had already begun to decline prior to this (i.e. during primary school). Previous research has suggested that a significant fall in activity levels occurs earlier in childhood (Vincent and Pangrazi, 2002) and that from as young as five years of age (as soon as children enter compulsory education in the U.K.), physical activity levels begin to fall (Trost et al., 2002). Although existing research tracking physical activity amongst young people suggests that the older they become, the more their physical activity falls (Pate et al., 1999; van Mechelen and Kemper, 1995), it is unclear whether the activity levels of pupils who participated in the present study will continue to fall as they leave school and move into adulthood. Therefore, there is clearly the need for more longitudinal research to be conducted amongst youth whereby activity is regularly monitored throughout childhood, adolescence and into adulthood to establish changes in activity level. This type of approach would offer a greater insight into the reasons for these changes.

With specific reference to age related changes in physical activity amongst certain population groups, the findings of the current study are more complex. Analysis of energy expenditure data revealed that in phase one, black boys were less active than black girls. However, in phase two it was the black boys who were more active than their female counterparts. Similarly, ethnic differences, irrespective of gender, were found between phase one and phase two of the study. In phase one, white participants were found to be significantly more active than their black and Asian peers. However, in phase two it was found that the activity levels of the white pupils fell to below those of black pupils. These findings can be explained with reference to the work of Hayes and Sugden (1991) who suggested that in British schools African Caribbean boys fail to demonstrate increased rates of academic achievement, and that stereotyping in school sport and PE during secondary education is responsible for this. During their time at secondary school, young black males may be actively encouraged to place less emphasis on more academic areas of the curriculum and to engage in physical education and school sport, subsequently, with age, they have increasing opportunities to engage in activity. However, this area will be discussed in greater depth later.

5.1.3 Physical activity and ethnicity

The findings of the present study indicate that young people from Asian ethnic minority groups participate in significantly lower levels of physical activity compared to those from white and black groups (mean energy expenditure values for white, black and Asian groups for phase one was 39, 38 and 36 kcal kg^{-1} day^{-1}). Young Asians were found to expend significantly less energy compared to white and black participants. This difference is equivalent to approximately thirty minutes less of moderate activity per day. Similar ethnic differences were reflected according to time spent in moderate and vigorous activity. Young Asians were found to engage in fewer minutes of both moderate and vigorous activity than their white and black counterparts (white participants engaging in approximately 25 minutes more and black participants 15 minutes more moderate activity). However, no significant main effect was found between the energy expenditure of white and black ethnic groups although a significant time by ethnicity interaction was revealed (described in the previous section).

Previous research has found that amongst the adult population in the U.K. people from certain ethnic minority groups have been found to be less active than the general population (Fischbacher et al., 2004) and the current study suggests that this too is the case amongst young people. It has been claimed that members of the Asian community relegate the importance of structured physical activity behind other commitments including education, family life and religious duties (Sports Council, 1994). Although the majority of physical activity research carried out in Britain has been amongst adults groups, the findings of the current study has found young Asians to be less active than their white and black peers and supports the findings of Fischbacher et al., 2004), therefore, it can be suggested that, like their parents, young Asians relegate physical activity behind other commitments.

Another explanation for lower levels of activity amongst young people from Asian ethnic minority groups is the underrepresentation of Asians, more specifically Asian females, in British sport and sport media (Sports Council, 1994). This would result in very few sporting figures to act as role models for young Asian people to raise the profile of sport within Asian communities in Britain.

It is important to note that during school, Asian pupils have the same entitlement to curricular and extra curricular PE as their black and white counterparts. However, research has indicated that young people from certain ethnic minority groups experience conflict between cultural and religious practices and physical education (Carroll and Hollinshead, 1993). Thus, culture and religion influence the extent to which these individuals participate in school-based activity (including extra-curricular activity). However, as previously stated, it is beyond the remit of the present study to distinguish between physical activity levels during PE, school sport and out of school leisure time activity. As suggested by Rose (1997), although all pupils have equal access to the curriculum, they do not necessarily have equality of opportunity. For example, it has been questioned whether schools have considered the timing of extra-curricular sporting activities in relation to accessibility to members of South Asian communities (Siraj-Blatchford, 1993). For instance, organising extra-curricular activities for lunchtimes as opposed to after school. Therefore, if more suitable timings for such extra-curricular activities were found then young people would not be forced to relegate them behind other commitments. As previously suggested by Siraj-Blatchford (1993) greater collaboration between schools and religious communities would provide other ways in which extra-curricular activities can become more accessible to young people from ethnic minority groups. Although the findings of the current study indicate that pupils from minority Asian groups are less active than white pupils, do interaction was found across the different days of the week, therefore, further research is required to establish whether this difference in activity is due to lower levels of participation in physical education and school sport or due to out of school activity. Furthermore, qualitative research should seek to establish barriers to participation experienced by Asian youth in Britain and whether British schools are currently providing equality of access for all pupils by offering young people from ethnic minority groups (particularly those from South Asian communities) with the types of activities in which they want to participate, or indeed, whether the organisation and timetabling of such activities fosters participation.

It would be reasonable to assume that people from black ethnic minority backgrounds can also face similar barriers to participation, however, as previously mentioned, no statistically significant difference was found in energy expenditure between white and black pupils. The fact that black participants were found to be more active than Asian pupils and had similar activity levels to white pupils can be attributed to the overrepresentation of black pupils in school sport, a notion previously discussed by Carrington (1982). Research has indicated that the participation of black pupils in school sport is due to the stereotypical misconceptions and active encouragement of teachers (Hayes and Sugden, 1999). The wide spread media coverage of both black male and black female sporting icons also provides young black people with role models to develop a culture of participation in sport and physical activity. However, as previously reported by Coakley (1998) this representation is in a limited range of sports and therefore school sport activity may be limited by choice.

As the current study has made inconsistent findings to indicate a statistically significant difference between the energy expenditure of white and black pupils, findings are in conflict with the research of McVeigh et al. (2004), Eisenmann, Bartee and Wang (2002), Gordon-Larsen, Adair and Popkin (2002), McGuire et al. (2002), Sallis et al. (1998) and Andersen et al. (1998). In all these studies white children were found to be more active with higher levels of inactivity (e.g. more time spent watching TV) amongst black and ethnic minority children (Eisenmann, Bartee and Wang (2002); Gordon-Larsen, Adair and Popkin (2002); McGuire et al. (2002); McVeigh et al. (2004); Andersen et al., 1998). However, it is important to note that the majority all the studies mentioned above were conducted in the U.S., therefore care should be taken when drawing comparisons with the findings of the present study, due to differences in culture. However, the work of McVeigh and colleagues, which was carried out in South Africa, observed a similar trend thereby suggesting that the difference in physical activity between the ethnic groups is not just limited to the U.K. and U.S.. Furthermore, different physical activity measures were used by the various researchers (i.e. accelerometry, retrospective interviews and different self-report questionnaires) as well as different indicators, for example time spent watching TV, time spent in MVPA and, in the case of the current study, energy expenditure, which can only corroborate the observed trend.

With reference to current activity guidelines, fewer young Asian people were found to participate in sufficient physical activity to maintain their health. Approximately one third of Asian participants failed to meet the minimum guidelines of at least 30 minutes of moderate to vigorous activity per day (HEA, 1998). With the strong association between physical activity and health previously established in the literature, the findings of the present study have revealed implications for the health of the Asian community living in the United Kingdom. These findings provide some explanation for higher death rates from coronary heart disease among South Asians as reported by Rai and Finch (1997). In addition, according to physical activity status a greater percentage of Asians were classified as inactive and very inactive compared with white and black participants thereby corroborating the findings of analyses regarding the amount of time spent in moderate activity. Due to the implications for health associated with a physically active lifestyle, the findings of the current study would suggest that more research is needed in the area of young Asians' activity levels.

Although larger numbers of white and black participants met the optimal physical activity levels (i.e. 60 minutes of accumulated five minute bouts of moderate to vigorous activity daily), approximately 9% of white 19% of black pupils failed to meet the recommended guidelines in phase one of the study. In phase two, approximately 15% of white and 21% of black participants were not engaging in the recommended amount of physical activity to accrue health benefits. Despite the inconclusive evidence base for the benefits of physical activity in young people (Patrick, et al., 2004; Twisk, 2001), research has suggested that cardiovascular disease risk processes originate in childhood (Thomas, Baker and Davies, 2003), therefore, the higher percentage of young black people failing to meet physical activity guidelines offer some explanation for increased death rates as a result of strokes among African-Caribbeans previously reported by Rai and Finch (1997). Physical activity status data presented a similar story with a higher percentage of black participants classified as either inactive or very inactive when compared to their white counterparts.

It is important to note that participation in physical activity can be dependent upon a number of barriers and, as highlighted by Rai and Finch (1997), these barriers can be practical in nature. In the context of people from ethnic minority groups this could manifest itself as a financial barrier. Due to the fact that ethnic minority groups tend to be financially disadvantaged and therefore, as previously discussed, stratified into lower socio-economic groups (Sports Council, 1994), young people may wish to engage in a physically active lifestyle but lack the financial support to facilitate this. Similarly, individuals can also be disadvantaged in terms of housing and therefore, the local environment in which they live is not conducive to physical activity, or indeed deemed safe for young people.

Although, the present study has attempted to provide further insight into the physical activity levels of young people from different ethnic groups, there is an awareness that the system of ethnic classification is somewhat limited. The classification of participants into three broad ethnic groups fails to distinguish between very distinct cultural groups. For example the 'Asian' group includes young people of both East Asian and South Asian descent and the many sub-cultures contained within these groups. Asian participants included young people with ethnic origins in the Indian sub-continent but whose parents were born in East Africa. Similarly, the 'white' category included young people from a variety of cultural backgrounds. 'White' included white British, white Irish and white traveller amongst other white categories. A young person classified in the white traveller category can face additional barriers to participation because of their ethnicity when compared to their white British counterparts who are in the majority ethnic category in the United Kingdom. Thus, the validity of such a system of classification can be called into doubt. However, disentangling the different sub-groups can be problematic particularly when taking a quantitative approach. Furthermore, it is important to note that it was the original intention of the study to have four ethnic categories (black, white, South Asian and East Asian). Limited participant numbers in the East Asian group and difficulties found with targeting such individuals resulted in East Asian and South Asian participants being re-categorised as 'Asian'. Additionally, it is recognised that all participants are not homogenous in terms of faith. Religious differences will contribute to individual differences and should not be underplayed.

Although the ethnic categories used in the present study can be questioned, the system of ethnic classification is based largely upon that used by LEAs which in turn originates from the National census ethnic classification system. It is the advice of the DfES (2002) that when pupil numbers fall to a low level in individual categories, that ethnic category should not be used. Given the quantitative focus of the current study, it was not deemed appropriate to have a wider range of ethnic categories, some of which would have contained very few pupils.

An additional concern with regard to the classification of ethnicity, is the accuracy of the information provided by schools. As previously mentioned ethnicity data was provided from school records. However, if responses to ethnic background questionnaires were not received from parents or pupils then schools ascribe individual pupils to an ethnic background based upon their best judgement. This may have resulted in individual pupils being classified incorrectly and not to the ethnic background that they or their parents identify with.

5.1.4 Physical activity and gender

The findings of the present study revealed that boys engaged in more physical activity than their female counterparts. Results indicated that, on average, boys expend two kcal kg^{-1} day^{-1} more than girls. This difference is largely due to the fact that, on average, boys engage in 20 minutes more of moderate activity and 20 minutes more of vigorous activity per day than girls. These findings support those of a number of previous studies which found boys to be more active and to participate in higher intensity activity for longer than girls (e.g. Armstrong and McManus, 1994). However, the findings of the present study identified a more marked difference between boys and girls when compared with those of existing research. Shropshire and Carroll (1998) found boys to engage in approximately one and half hours of total physical activity more than girls per week. The findings of phase one of the present study indicated that over the four days measured, boys spent over forty minutes more than girls in MVPA per day. If this difference is approximated for a week, boys would be engaging in over four hours more MVPA than girls.

There are various explanations for these differences between the two studies. Firstly, Shropshire and Carroll's (1998) research was conducted with participants in the last year of primary School (i.e. 10-11 years) whereas the current study was carried out amongst secondary school aged pupils. A review of research conducted by Cale and Almond (1992b) suggests that the drop-off in girls' physical activity participation occurs after the age of eleven years (i.e. post entry into secondary school) when the gap between boys and girls becomes wider. Differences between research findings can also be due to the data collection methods used. Although both studies administered self-report methods, the present study required respondents to recall the activities of the previous day whereas participants in Shropshire and Carroll's (1998) study reported activities engaged in over the past seven days. Both studies were dependent upon the ability of participants to accurately recall the type, duration and intensity of the activity engaged in but the reliability of ten to eleven year olds to recall information for up to a week can be questioned.

Although statistical analysis did not reveal a significant difference between boys' and girls' energy expenditure between phase one and phase two of the study, it is however important to note that the difference in MVPA between boys and girls became less. For phase one a difference of over 40min was observed between the boys and girls, however, in phase two this difference declined to approximately 35min. Thus, the difference between boys and girls MVPA became less over a period of twelve months. Previous reports have suggested that the activity gap between boys and girls becomes wider with age (Sallis, 1993). However, it would be inappropriate to state that the findings of the current study support the work of van Mechelen et al. (2000) who reported that it is boys' physical activity which declines more rapidly than girls'. The rate of decline between the two phases of the current study were similar for both boys and girls (approximately 18%), therefore no difference in the rate of decline in MVPA between secondary school aged boys and girls was found.

It is, however, important to note that with regard to the existing study there was considerable variability around the mean scores and this has previously been identified as an area to note (Pate et al., 1994). Some boys and girls engaged in substantially more time in MVPA than their peers. Similarly, there were individuals who participated in limited moderate activity and no vigorous activity during the measurement period. For example during phase one of the study, one girl reported tacking part in almost fourteen hours of vigorous activity over the weekend as she had attended a dance competition whereas, most participants failed to report a single bout of vigorous activity on a Saturday and/or Sunday.

With reference to physical activity guidelines during both phases of data collection, the majority of boys met the minimal requirements associated with benefits to health. Over three quarters of boys in phase one met optimal physical activity levels (i.e. over 60 minutes of MVPA per day). Amongst the girls the split between optimal, minimal and failure to meet child specific physical activity guidelines was more balanced. Approximately one third of girls fell into each of the three categories. This is a particular concern due to the fact that previous research has identified that as girls move through secondary education and adolescence, their physical activity levels are expected to deteriorate more markedly than boys (Armstrong and McManus, 1994; Sallis, 1993) and, as previous work has suggested inactive girls become more inactive women (Kemper et al., 1995). The fall in girls' physical activity between phase one and phase two of the current study is in line with the findings of Kemper et al. (1995) whose longitudinal study revealed that the physical activity levels of young Dutch women fell by 17% over a period of 15 years (Kemper et al., 1995). Thus, as they move into womanhood and the decline in physical activity continues, the health of young women who participated in the current study is at risk from inactive lifestyles.

When looking at physical activity status in both phases of the study the percentage of girls classified as either very inactive or inactive was greater than that of their male peers. Therefore, findings support those reported above indicating that young females are less active than males. However, physical activity status data suggested a more marked gender difference with approximately 30% more girls than boys either inactive or very inactive for both phases of the study.

Although research conducted in the area has revealed an association between physical activity levels and age and that the decline in physical activity is more marked in girls than amongst boys, the findings of the present study has revealed a significant decline in boys' physical activity as they move through secondary school. It can be seen that between phase one and phase two of the study the physical activity levels of boys fell. In phase two a lower percentage of boys were classified either moderately active or active than in phase one. Similarly, less time was spent in MVPA. Subsequently, a greater percentage of boys were failing to attain the child specific physical activity guidelines (i.e. a minimum of 30 minutes of accumulated MVPA) and fewer were reaching the optimal guidelines of 60 minutes of MVPA. These findings support those of Gavarry et al. (2003) and Kemper et al. (1995) which revealed an age related decline for boys. However, both of these studies found the decline to be more marked than for girls. The research of Gavarry et al. (2003) revealed school day percentage declines of 69% and 36% between childhood and adolescence for boys and girls respectively. It is important to note that the work of Gavarry and colleagues was a cross-sectional study and subjects were not randomly selected thus questioning the validity of the conclusion drawn. Nevertheless, the Amsterdam Growth Study made similar findings with a male percentage decline of 42%, the majority of this fall occurring between the ages of 13 and 18 years, compared with a decline of only 17% amongst females (Kemper et al., 1995). As previously mentioned, the current study did not identify significant differences in the longitudinal decline of energy expenditure between boys and girls. However, descriptive statistics for energy expenditure showed a percentage decline of 2.3% for boys and 1.9% for girls over a period of twelve months. Therefore, results suggest that although girls expend significantly less energy than boys and are therefore on the whole less active than boys, girls' activity levels remain more constant than boys' (i.e. as they move from adolescence to adulthood). A more complex pattern of behaviour was observed by Janz, Dawson and Mahoney (2000) who concluded that, although vigorous activity and inactivity (as defined by the amount of time spent watching TV and playing computer games) were relatively stable variables, vigorous activity tracked better in girls, whereas sedentary activity tracked better in boys.

Clearly, the discrepancy in the rate of decline in boys' and girls' activity in the current study warrants continued investigation and longitudinal analysis of physical activity data amongst the adolescent population should elicit more information on the differences between boys and girls and the reasons for the differences in physical activity tracking.

5.2 Attitudes towards physical education

The results of young people's attitudes towards physical education will be discussed in terms of the relationship between total attitude towards physical education and each of the five questionnaire factors: general interest, assessment, PE teacher, environmental adjustment and organisational choice, and physical activity. In addition, differences in young people's attitudes towards physical education according to ethnicity, school year and gender will be discussed.

5.2.1 Relationship between attitude towards physical education and physical activity

The relationship between attitude towards PE (total attitude score and scores for each of the five factors) and physical activity levels will be discussed for both phases of the current study.

Data from phase one indicated that young people's total attitude and general interest towards PE was significantly and positively correlated with average daily energy expenditure and time spent in both moderate and vigorous activity. In phase two similar findings were revealed although no significant relationship was found between total attitude towards PE and time spent in moderate activity. These relatively consistent findings across both phases of the study support the theory that attitudes predispose us to act the way we do, and therefore the work of Eisner (1994), indicating that those individuals who hold a more positive attitude towards PE are more physically active and engage in activities with a higher energy cost and of longer duration. This would suggest that during early adolescence, positive attitudes towards PE have the potential to encourage lifelong physical activity and supports previous research (Sleap and Warburton, 1992).

The relationship found between pupils' attitudes towards their PE teachers and physical activity levels from phase one would suggest that vigorous activities, which incorporate traditional school team sports/activities, are more popular amongst young people who hold a positive attitude towards their teacher. This finding reinforces the role of significant others in the formation of attitudes (Ajzen and Fishbein, 1980)[14], therefore, a pupil who holds a positive attitude towards their PE teacher will expend more energy and engage in higher intensity activity. It is important to note that although significant, the correlation was weak and that no such significant relationship was found in phase two thereby indicating that findings are inconsistent thus, as pupils age and move through adolescence, the relationship between attitude towards PE and physical activity levels is less affected by their attitude towards the PE teacher.

Although significant relationships between physical activity variables and total attitude were found, certain factors of the questionnaire (i.e. environmental adjustment and organisational choice factors) show no association with physical activity variables and therefore bring into question whether contextual factors such as the wearing of PE kit and the environment in which PE takes place foster negative attitudes towards PE and subsequently a physically active lifestyle. This finding is contrary to that previously reported by Williams and Bedward (1999) who suggested that contextual factors were more important than the physical activity itself in young people's dislike for PE.

With reference to phase two of the current study, similar findings were revealed. Significant yet weak, positive relationships were found between total attitude scores and energy expenditure and time spent in vigorous activity. Similarly, there was some replication with reference to the relationship between energy expenditure and time spent in moderate and vigorous activity and the general interest domain. However, there was no further overlap between the two phases to corroborate findings.

Findings indicated that the general interest domain remained fairly constant over time. Significant positive relationships were revealed with physical activity variables across both phases of the study, therefore suggesting that physical activity levels are most greatly influenced by a positive general interest in the subject area of PE and that attitudes toward the PE teacher, assessment, organisational choice and environment do not impact upon activity levels. Previous literature, however, has provided theories to the contrary. Firstly, Macfadyen (2000) reported that PE teachers were the most influential figures in the formation of positive attitudes towards physical activity amongst adolescents. Furthermore, contextual factors (e.g. PE kit) are what are disliked by pupils as opposed to the subject itself (Williams and Bedward, 1999). In conclusion, irrespective of attitudes held in other domains, a positive relationship between general interest in PE and physical activity levels was found.

It would therefore appear that the relationship between attitude towards PE and physical activity is complex. As positive relationships between attitude towards PE and physical activity were identified the findings of the current study support the link between attitude towards the behaviour, the intention, and behaviour as hypothesised by the theory of reasoned action (Ajzen and Fishbein, 1980)[14] (Figure 2.) and, although the findings of the present study were inconclusive (i.e. weak yet significant relationships, inconsistency between phase one and phase two) they go some way to support the notion that attitude does not always predict behaviour. Ajzen and Fishbein (1980)[14] proposed that attitudes should not be expected to predict behaviour due to the fact that individuals place differing levels of importance upon attitudinal and normative components (i.e. beliefs about the consequences of the behaviour and how the behaviour will be received by significant others). Therefore, more research into the relationship between young people's attitudes towards PE and physical activity is required to inform relevant professionals, especially PE teachers, to enable the appropriate development of future curricula and delivery.

5.2.2 Attitude towards PE and ethnicity

In phase one a significant difference was found in attitude towards PE held by young people from different ethnic groups. Overall, Asian respondents held a significantly more positive attitude towards the subject than black and white pupils. This finding is in conflict with physical activity data which suggested that Asian pupils expended less energy than white and black pupils. Thus, Asian pupils hold more positive attitudes towards the subject of PE but are less active. In addition, more complex higher order interactions were revealed.

The total attitude towards PE scores of all girls followed an age related decline with young pupils holding a more positive attitude towards the subject than older pupils. For white and Asian boys a similar pattern was observed, however, for black boys attitudes towards PE was more positive among older pupils. This increase in attitude mirrored a similar increase in physical activity among black boys. As findings revealed young black males to hold a more positive attitude towards PE, this can go some way towards supporting previously published findings into the overrepresentation of black boys in school sport and the fact that achievement in PE is at the expense of more academic curriculum subjects (Hayes and Sugden, 1999). It has previously been suggested that some PE teachers see it as beneficial for black male pupils to be successful in sport (Hayes and Sugden, 1999). The work of Carrington from the early eighties can be used to explain these beliefs; some teachers still consider black people to possess skills of the body and not of the mind (Carrington, 1982). PE teachers who take this stance would therefore invest time and effort in actively engaging black male pupils in PE and school sport. Therefore, these individuals develop more positive attitudes towards the subject area and subsequently foster greater engagement with higher intensity physical activities and competitive sport than other groups of pupils.

It has previously been advocated that physical education and schooling promotes active lifestyles (Cale and Harris, 2006; Shropshire et al, 1997), and, that attitude predicts behaviour (Eiser, 1994). However, the findings of the present study do not consistently agree with this theory. The findings of the current study suggest that not only do black boys hold more positive attitudes towards PE, they are also more active than other groups. This supports the idea that attitude predicts behaviour. Conversely, and irrespective of gender, Asians were found to hold more positive attitudes towards PE yet were found to expend less energy, engage in less MVPA and have higher percentages classified inactive or failing to meet activity guidelines than other ethnic groups. It is therefore questioned whether total attitude towards physical education is what predisposes young people to engage in greater or lesser amounts of activity. However, the theory of reasoned action (Ajzen and Fishbein, 1980)[14] can be used to explain this discrepancy. Black boys are more active because their subjective norms and attitudes are pulling in the same direction: they have a positive attitude towards PE and believe that being physically active and engaging in sport gains approval from friends and family. However, for Asian boys and girls, attitudes and subjective norms are pulling in opposite directions: they hold positive attitudes towards PE but believe that significant others will disapprove of high physical activity levels. Furthermore, the relative importance of attitudinal and normative considerations may differ for different ethnic groups (e.g. young Asians place greater importance upon the normative component).

Attitude data collected in phase one of the study revealed significant school year by gender by ethnicity interactions in three of the five factors within the PAAPEQ: general interest, assessment and organisational choice factors. The attitudes of black boys in general interest and assessment factors became more positive as they moved through the school years. General interest towards PE became more positive amongst black males whilst the attitudes of their white and Asian counterparts either declined or remained constant. Thus, it can be suggested that total attitude towards PE is not responsible for predicting physical activity, it is attitude towards specific domains within the PAAPEQ which is important. In addition, within different ethnic groups, positive attitudes towards certain domains have more influence on physical activity levels. Asian participants had more positive attitude scores overall yet were the least active of the ethnic groups. However, black boys who hold more positive attitude towards the general interest domain were the most active group.

These findings were not replicated in phase two indicating that ethnic differences in attitude are complex. An ethnicity by gender interaction was found with boys and girls from black and Asian ethnic groups holding similar attitudes towards PE although male values were slightly above those of their female peers, however, white girls held a substantially less positive attitude than white boys. Thus, in phase two, as all participants have aged by twelve months, the decline in positive attitudes towards PE shown by white girls is of most concern. If, as research suggests, PE lessons and positive pupil attitude towards the subject area have the potential to foster a physically active lifestyle, then the findings of the present study go some way to support previous physical activity research. The majority of existing studies conducted in the UK (Cale 1993; Harris 1998; and Shropshire and Carroll 1998), reported school aged males, irrespective of ethnicity, to be more active than their female peers. Furthermore, given that white people are the largest ethnic group in the UK, this conclusion could be based upon the findings of research conducted with predominantly white pupils.

It is important to note that participation in physical activity is not solely dependent upon attitude. Additional barriers, as previously discussed and reported by Rai and Finch (1997) can be practical in nature. In the context of people from ethnic minority groups, the barrier can be a financial one given that England and Wales 2001 census data indicated that people from ethnic minority groups are more likely than white people to live in low-income households (National Statistics Online, 2006). Therefore, individuals from ethnic minority groups hold positive attitudes towards PE and physical activity but lack the financial support to enable them to pursue a physically active lifestyle. In addition, they may not live in an environment which fosters physical activity, nor indeed is safe enough to do so. This hypothesis has previously been suggested by Andersen et al. (1998) who reported that minority populations are more likely than Caucasians to report their neighbourhoods as being unsafe. Also, among Belgian adults, it has previously been found that socio-economic status is related to a more ‘activity friendly’ environment (De Bourdeaudhuij, Sallis and Saelens, 2003). Therefore the environment and local area in which ethnic minority groups live inhibits future physical activity or sports participation. As so many gender by ethnicity interactions were revealed as a result of the analyses conducted, there is a case for future research to focus on gender differences within different ethnic groups and the environmental factors which can have an impact upon attitude towards PE and physical activity.

5.2.3 Age related attitudes towards PE

A significant age related decline in total attitude towards PE was revealed for both phase one and two with attitude scores less positive amongst older pupils. Furthermore, data also suggested that if mean values are tracked over time, the attitude scores of representative pupils from each school cohort decreased and are therefore less positive. However, as previously mentioned total attitude scores may not be a t rue indication of attitude towards PE. Certain domains within the PAAPEQ provide a better picture of the nature of attitude towards the subject.

With reference to the domains of the PAAPEQ, only the general interest domain revealed significant differences according to age. These findings replicated those for the total attitude score in that mean values declined both cross-sectionally (with school year) and longitudinally (between phases one and two). Thus, the findings of the current study support the notion that attitudes are relatively permanent and persist over time (Hogg and Vaughan, 1998).

Attitude towards PE (specifically general interest in PE) becomes less positive as pupils move through secondary school. In addition to the current study, a number of previous studies (Pate et al, 1994; Trost et al, 2002; Harris, 1998) have identified an age related decline in physical activity. Therefore, physical education is failing to foster positive attitudes towards a physically active lifestyle as these findings go some way to support existing physical activity research.

5.2.4 Gender and attitudes towards PE

No significant difference in total attitude scores was revealed according to gender from either phase of the study. These findings suggest therefore, that neither male nor female pupils held significantly more positive attitudes towards PE than their peers of the opposite gender. Similarly, analysis conducted on the five domains in the PAAPEQ failed to produce any consistent findings.

However, as previously reported, gender by ethnicity interactions for total attitude scores were found. Boys and girls from black and Asian ethnic groups were found to hold similar attitudes towards PE although male values were slightly above those of their female peers, whereas white girls held a less positive attitude than white boys. Findings indicate that differences between boys and girls attitudes are complex and cannot be separated from other confounding variables such as ethnicity and school year thereby suggesting that any gender differences are most likely due to their school year and their ethnicity as opposed to gender per se. Therefore, differences in attitudes between the genders cannot be attributed to biological differences between boys and girls, which can be used to explain differences in health-related fitness variables, but due to other socio-cultural factors.

5.3 Health related fitness

Young people's physical fitness levels will be discussed in terms of the relationship between the components of physical fitness and physical activity levels as well as differences in physical fitness according to ethnicity, school year and gender.

5.3.1 Relationship between health related fitness and physical activity

A number of inconsistent yet statistically significant relationships were found between physical activity and physical fitness variables. For example, in phase one, significant positive relationships were found between cardiovascular endurance, as predicted using the Multistage Fitness Test, and energy expenditure and time spent in vigorous activity. Thus, those young people who participate in activities with a high energy cost possessed a higher level of aerobic fitness. These findings support those of Sallo and Viru (1996) who found a positive relationship between children's physical activity and aerobic fitness. However, it is unclear whether young people had higher levels of cardiovascular fitness because they were more active and participated in more physically demanding activities or because they possess greater levels of genetically determined cardiovascular fitness. In addition, engagement in higher intensity activity results from possessing higher levels of cardiovascular endurance. Nevertheless, no such findings were revealed for phase two of the study to support initial cross-sectional findings.

Consistency in results across repeated measurements was shown for only one health-related fitness variable, that being muscular endurance as measured by the number of sit-ups completed in 30 seconds. In phase one positive correlations were revealed between muscular endurance and energy expenditure, time spent in moderate activity and time spent in vigorous activity. In phase two this was replicated with the exception of time spent in moderate activity. Therefore, participants who take part in activities with higher energy costs develop greater levels of abdominal muscular endurance.

Alternatively, due to the demands of the activities in which young people participate, including competitive team sports, greater levels of core stability and abdominal strength are required.

The fact that little association between physical activity and fitness variables has been found and that findings have not been consistent across phase one and phase two would suggest that physical fitness in young people is for the most part genetically determined and not greatly affected by physical activity levels. This notion is supported by the work of Riddoch and Boreham (2000) who state that although young people's fitness can be improved by regular activity, it is largely dependent upon genetic inheritance. Although research indicates that children and young people are failing to achieve the recommended frequency, duration and intensity of activity to accrue health benefits, previous studies have failed to reveal that young Britons are any less fit than previous generations (Armstrong et al., 1994; Armstrong et al., 1996).

The findings of the current study fail to indicate that there is indeed a link between childhood physical activity and childhood fitness as suggested by Blair's (1989) model (Figure 1.) as no significant relationship between physical activity levels and health in childhood was observed. However, as Blair's (1989) model reflects, the effects on health of low physical activity levels during childhood and adolescence are seen in young adulthood.

It is important to note that the measurement of health-related fitness components was carried out with a sub-sample of the overall sample and, therefore, the sample size was smaller than for the assessment of physical activity and attitudes towards PE. Due to the participant attrition rate, the sub-sample for fitness testing in phase two was smaller than for the phase one (35% and 26% of the overall sample for phase one and phase two respectively). As a result, a few extreme scores could have affected the data and the strength of any relationships revealed. In addition, individual participants elected not to take part in the measurement of certain health-related fitness components. For example, some did not want their body composition assessed or did not wish to run the multistage fitness test. Therefore, the consistency of the findings across repeated measures could have been affected by a fall in subject numbers. As participants provided their consent to take part in the study, the representativeness, of the data can be questioned. However, as previously discussed, it was established that those who participated in both phases of the study were representative of the original sample (including those who did not provide consent for phase two of the study) as independent t test did not find significant differences according to selected health-related fitness measures.

It may also be questioned whether, with the exception of measures of stature and body composition, values attained by participating young people reflected their motivation to perform or their physical capacity in each of the components measured. Concern over the use of field tests to measure physical fitness has previously been raised and questions regarding reliability, validity and usefulness asked (Boreham and van Praagh, 2001; Armstrong and Biddle, 1992). It should be acknowledged that laboratory settings can especially lack ecological validity for children and in some instances still require a substantial level of participant motivation. In addition, it can also be queried whether children and young people who perceive themselves as unfit would give their assent to participate or try to achieve their personal best on some or all of the measures taken. However, the same can also hold true for field based measures of health-related fitness. Additional research into the measurement of health related fitness is required to increase the validity and reliability of the different test items which in turn better informs researchers, physical education teachers and health practitioners of the current and changing health related fitness of young Britons. Information gleaned can then be used to update initiatives and policies to help to improve the health of the nation.

5.3.2 Percent body fat and body mass index

The percent body fat of participants was calculated using the child specific prediction equations devised by Slaughter et al. (1988) with skinfold measurements taken from the triceps and medial calf sites. However, it was acknowledged prior to data collection that although this method and these sites were considered more appropriate due to nature of the participants involved (i.e. secondary school aged pupils from diverse ethnic backgrounds) there have been reservations expressed over the accuracy of the sites to predict percent body fat (Janz et al., 1993). Therefore, BMI was also calculated and data obtained analysed to support the findings of the analyses conducted on skinfold data.

Results obtained indicated that between the two phases of the study, average body fat percent significantly increased by 1% (from 19.8% to 20.9%). However, no such significant difference was found for BMI. Analysis conducted on BMI data did reveal a significant interaction which suggested that boys' BMI values decrease with time (between phases one and two) whereas girls' values remain relatively stable. Mean values for percent body fat suggest that it is boys' percent body fat which remains relatively stable (an increase of less than 0.5%) while girls' increases by almost 2%. Therefore, both skinfold and BMI data indicated that in terms of body composition there is some interrelationship between age and gender with girls' body fat increasing over a period of one year. However, no clear picture was established for boys as BMI suggested that body fatness decreases whereas skinfold technique suggested that body fat remains stable. When young people enter secondary education, girls tend to be taller than boys due to the fact that females enter the adolescent growth spurt before males. Armstrong and Welsman (1997) and Malina et al. (2004) discuss this age related difference and both report that this difference between the peak height velocity of boys and girls of the age participating in the current study can be as much as two years. It is widely accepted that after the point of sexual maturation there is a tendency for males to be heavier than females due to an increase in fat free mass (i.e. larger skeleton, greater muscle mass and lower percent body fat) and the findings of the current study revealed that girls possess higher percent body fat values compared to boys. Therefore, as secondary school pupils age and move through puberty the differences in body fat between the genders increases.

In regard to ethnicity, complex patterns were observed for both percent body fat and BMI and with both of these measures, ethnicity by school year interactions were revealed. The percent body fat of black pupils was found to increase with school year (by approximately 1% each year). Furthermore, BMI data supported this and values for black pupils increased with school year. Similarly, BMI data for Asian pupils showed an increase with school year. Therefore, Asian pupils are at greater risk of becoming overweight adults compared to white and black pupils. Freedman, Khan, Serdula, Dietz, Srinivasan and Berensen (2005) identified racial differences in the tracking of childhood BMI to adulthood with higher percentages of overweight black girls and boys than white girls and boys becoming obese adults. The findings of the current study have observed the beginning of a similar trend for Asian adolescents, although no such pattern was observed for black adolescents.

Percent body fat data for both Asian and white groups failed to show consistent trends across the three school years measured (e.g. among Asian pupils, body fat was higher in year B than in years A and C; among white pupils, body fat was lower in year B than in years A and C). It is important to note that growth is typified by differences between and within the different population groups primarily due to genetic factors. Therefore, there can be considerable variability between individuals of the same age, gender or ethnicity. However, growth and maturation are not solely characterised by genetic factors but are also influenced by environmental factors.

It should be noted that, when compared against the international cut-offs for overweight and obesity (BMI values of 25 kg/m^2 and 30 kg/m^2; Cole, Bellizi, Flegal and Dietz, 2000), the mean BMI values for the different groups in current study revealed boys, black participants, and those in year A and year B to be below the cut-off for overweight. However, girls, white and Asian participants, and those in year C are at risk as their BMI values were above the overweight cut-off below the obesity cut-off but. Therefore, research targeting older secondary school years, girls, and white and Asian pupils is required.

The extent to which physical activity levels amongst young people influence body composition can also be brought into question. As previously discussed no significant relationship between physical activity and body composition was found. However, it is widely accepted that an imbalance in energy intake and expenditure results in an increase or decrease in body fatness. Thus, an active lifestyle, and sensible and balanced diet helps to maintain body fatness.

Although it is acknowledged that alternative measures of body composition exist, both skinfold techniques and BMI are particularly attractive as measures for use with children and young people as they are generally non-invasive, less demanding upon participants and can be used in the field, the findings of the current study were inconclusive with discrepancies between percent body fat and BMI values. Therefore, more research is required to establish the most appropriate and valid measures of body composition for use with young people which will enable the comparison of different population groups and in turn help to target interventions with the most at risk groups.

5.3.3 Cardiovascular endurance

The findings of the present study revealed no age related differences (neither cross-sectional nor longitudinal) in predicted cardiovascular fitness. This is contrary to previously published work that suggests that throughout adolescence to biological maturation cardiovascular fitness increases (Armstrong and Welsman, 1994)[32]. Possible explanations for this finding can be associated with both gender related differences as well as energy expenditure levels. A nalysis revealed that boys had a g reater level of predicted cardiovascular fitness compared with their female counterparts, furthermore, that the difference between boys and g irls increased between phases one and two. For phase one, the mean difference between boys' and girls' cardiovascular endurance was 2.5 $ml \cdot kg^{-1} \cdot min^{-1}$, whereas, for phase two the difference was 5 $ml \cdot kg^{-1} \cdot min^{-1}$. Girls' cardiovascular endurance remained relatively constant over the twelve month period between testing while boys' endurance increased. H owever, reasons for the difference in predicted cardiovascular fitness between males and females of secondary school age are complex.

As the current study found that boys were significantly more active than their female counterparts, it can be concluded that cardiovascular fitness is related to physical activity levels as previous research has indicated (Riddoch and

[32] Armstrong,N. and Welsman,J. (1994) Assessment and interpretation of aerobic function in children and a dolescents. *Exercise and Sports Science Reviews*, 22, 435-476. C ited in Armstrong and Welsman (1997)

Boreham, 2000). In addition, significant positive relationships between some physical activity variables and cardiovascular fitness levels during phase one of data collection were also evident. The difference may also be explained in terms of physiological differences between males and females. It is important to note that irrespective of the difference found between the genders, mean values for cardiovascular fitness for both boys and girls are bordering on risk levels. Work by Bell and colleagues (1986) proposed risk levels of 35 $ml·kg^{-1}·min^{-1}$ and 30 $ml·kg^{-1}·min^{-1}$ for boys and girls respectively. In phase two of the current study, mean peak VO_2 for boys and girls was 36.5 $ml·kg^{-1}·min^{-1}$ and 31.5 $ml·kg^{-1}·min^{-1}$. Therefore, close monitoring is required to establish whether young people's cardiovascular fitness is declining due to the implications to health

The method of assessing cardiovascular fitness among young people should also be considered. Due to the fact that health-related fitness is a compulsory element in the National Curriculum for PE in Key Stages 3 and 4, the Multistage Fitness Test is widely used by British secondary schools in the assessment of cardiovascular fitness (Harris, 1995). Thus, the majority of young people who participated in the current study were familiar with the test and may have unfortunately, developed negative attitudes towards the test. Cale and Harris (2002) have considered the possible impact of fitness tests upon the values of young people towards activity. This is most likely due to the way in which the fitness tests are administered which young people find uncomfortable and embarrassing and, particularly in the case of the multistage fitness test, reinforce the notion that exercise is competitive

(Rowland, 1995). Although all participants were encouraged to continue the test until they could run no further, informal observation during the administration of the test suggested that some participants dropped out during the early stages of the test even though they did not show any obvious outward signs that they had run to their maximal (i.e. breathing heavily, hot and sweaty). From observation, this behaviour was more notable amongst the girls. To establish whether participants were indeed working at a high intensity when they dropped out of the multistage fitness test, heart rate could have been monitored throughout the test administration.

Performance on the multistage fitness test could therefore, be assessing participant motivation levels and not cardiovascular fitness levels per se. However, it is important to note that alternative measures have their own limitations and given the sample size and nature of the current study, the multistage fitness test was deemed a more appropriate indicator of cardiovascular endurance than other field tests or indeed laboratory measures. Given that informal observations of the participants during testing suggested that it was more common for girls to drop out of the multistage fitness test before they had given their maximal effort, the difference in cardiovascular fitness between boys and girls could therefore be associated with the test administration, and not differences in actual fitness levels. As no further significant differences were observed according to ethnicity, school year or between phases one and two of the study, one cannot be certain whether there are indeed no differences between these groups or whether the test administration failed to accurately estimate cardiovascular endurance.

Therefore, more research using different methodologies is required to establish whether there are indeed differences in the cardiovascular fitness between young people according to ethnicity, age and gender.

5.3.4 Flexibility

As previously reported a significant difference was revealed according to ethnicity with no further gender or age related differences found. For phase two, mean values indicated that black participants possessed higher levels of flexibility and reached approximately 5cm further than both white and Asian participants. Although the difference between black participants, and white and Asian participants is marked, it must be acknowledged that the number of young black people who participated in the measurement of health-related fitness variables was limited. Consequently, a few participants with particularly high levels of flexibility could have created considerable variability around the mean. Therefore, it is recommended that further research be conducted in the area to confirm the findings of the current study. Additionally, future work is required to establish whether differences can be attributed to genetic and/or behavioural differences between ethnic groups.

As the current study did not find a significant relationship between flexibility and physical activity variables, it is suggested that flexibility of the hamstrings and lower back is not influenced by energy expenditure or the amount of time spent in moderate and vigorous activity in youth. This supports the notion that fitness variables are largely genetically predetermined and that participation in certain physical activity and sport will only enhance individual predisposition.

(Riddoch and Boreham, 2000). Future research should be conducted into the different types of activity young people engage in to establish whether those activities which demand, and therefore develop, higher levels of flexibility (e.g. gymnastic type activities, martial arts), reduce the risk of injury and protect against conditions developed in later life such as low back pain (Department of Health, 2004; Vuori, 2001).

5.3.5 Muscular endurance

The association between muscular endurance, as measured by sit-ups, and physical activity variables has been previously discussed. In addition age related changes in abdominal muscular endurance have been found. Both longitudinal and school year differences were found with muscular endurance increasing with age. On average, participants completed almost three more sit-ups in phase two than they completed in phase one. In addition, for both phase one and phase two, year C completed more sit-ups than years A and B. These findings can be attributed to the increase in muscle mass with chronological age. However, the increase in muscle mass is more marked amongst adolescent boys than girls (Armstrong and Welsman, 1997).

Higher levels of abdominal endurance possessed by males (approximately 4 more sit-ups in 30 sec. than girls) can be due to the previously established link between vigorous activity and muscular endurance. Additionally the difference could be attributed to pubertal changes in muscularity between boys and girls; that being, the percentage gain for boys is greater than for girls during puberty. Ethnic differences are more difficult to explain. Black participants were found to possess greater levels of muscular endurance than their white and Asian peers with Asian pupils completing fewest sit-ups of all three ethnic groups. Black participants completed approximately 2 more sit-ups than both white and Asian participants. Although a positive relationship was found between physical activity and muscular endurance for all participants, black pupils were not found to expend more energy than white pupils (although they did expend significantly more energy than Asian pupils). Again, future work should attempt to establish whether differences can be attributed to genetic and/or behavioural differences in muscular endurance between ethnic groups.

Due to the smaller sample who participated in measures of health related fitness no higher order ethnicity interactions were found and data analysis did not distinguish between boys and girls within each ethnic group. However, as previously reported, analysis conducted on physical activity data established that as they age, young black males expend more energy and participate in more MVPA than other groups. Therefore, black participants as a group were found to possess higher levels of muscular endurance due to higher levels of muscular endurance and increased physical activity levels amongst black males. Further research is required to explore the ethnic differences found in the current study in relation to gender.

5.3.6 Muscular strength

Differences in the muscular strength of the dominant and non-dominant hand were found according to age and gender. Both longitudinal and cross-sectional changes in grip strength were found with young people's grip strength increasing with school year. Between phase one and phase two, on average, muscular strength of both dominant and non-dominant hands increased by approximately 2kg. These findings replicate those of muscular endurance. Therefore, as pupils age their muscular strength increases. The findings of the current study support the notion that strength increases with growth as muscle mass increases (Bar-Or and Rowland, 2004). Furthermore, gender and age related differences in muscular strength can be attributed to gender and age related changes in muscle mass gain through puberty as previous work has suggested that until the pre-pubertal years (approximately 11 years of age), girls and boy s possess similar strength values with considerable overlap between the sexes (Armstrong & Welsman, 1997). It is at the age of approximately 13-14 years, that boys' strength accelerates whereas girls' strength shows little or no acceleration (Bar-Or and Rowland, 2004). Therefore, patterns of strength gains amongst the boys and girls who participated in the current study are in line with that previously reported in the literature.

5.4 A model of physical activity, physical education, and health related fitness in young people

The findings of the current study did identify significant, although inconsistent, relationships between physical activity variables and some of the health related fitness components measured, although it has previously been suggested that the evidence base for such associations between physical activity during childhood and childhood health is weak and it has been advocated that further research be conducted (Riddoch, 1998; Twisk, 2001; Guerra et al., 2006). As the current study has not directly measured the health of young people (nor indeed the physical activity and health of adults), Blair's (1989) model depicting the hypothetical relationships between childhood and adult physical activity and health (Figure 1 presented earlier) cannot be directly applied to the findings. Therefore, there is the need to provide an alternative model which considers the associations found between physical activity and health related fitness (and therefore an indicator of health status) to provide a hypothetical relationship with health in youth.

With regard to the effect of independent variables on the physical activity levels of young people, the current study has established the simultaneous effects of ethnicity, gender and school year on weekday and weekend activity levels. Differences in the health related fitness of young people from these different population groups were also found. Subsequently, Blair's global model, although broadly applicable, fails to encompass the effect of independent variables on a life course approach to physical activity and health.

With reference to attitude towards physical education, the findings of the current study revealed consistent positive relationships between attitude (particularly total attitude towards PE and general interest factors) and physical activity. This provides an explanation for why certain individuals are more active than other young people. However, to achieve this, the theory of reasoned action needs to be applied. The TRA asserts that attitude does not predict behaviour but can be used to predict intention moreover, that intention is affected by the relative importance an individual places upon attitudinal and normative components. T herefore, as the findings of the current study revealed positive relationships between attitude towards PE and physical activity, attitude towards the behaviour (attitude towards PE) can be used to predict the behaviour (physical activity). However, the extent to which young people place relative importance upon the attitudinal component compared to their subjective norm has not been established in the current study.

Similar differences in attitude towards PE were found according to the independent variables of ethnicity, gender and school year. Based upon the prediction of physical activity behaviour from attitude towards PE, those population groups who hold more positive attitudes will be more active (for example, black boys held more positive attitudes towards PE and expended more energy than other groups). However, the findings of the present study do not consistently agree with the notion that attitude predicts behaviour. Young Asians were found to hold more positive attitudes towards PE yet were found to expend less energy, engage in less MVPA and have higher percentages classified inactive or failing to meet activity guidelines than other ethnic groups. The TRA can again be used to explain this discrepancy. Black boys are more active because their subjective norms and attitudes are pulling in the same direction: they have a positive attitude towards PE and believe that being physically active and engaging in sport gains approval from friends and family. However, for young Asians, attitudes and subjective norms are pulling in opposite directions: they hold positive attitudes towards PE but believe that significant others will disapprove of high physical activity levels. Therefore, the relative importance of attitudinal and normative considerations differ for different population groups (e.g. young Asians place greater importance upon the subjective norm component). The TRA has been criticised as the theory does not consider behavioural barriers which prevent the behaviour being totally volitional (Biddle and Mutrie, 2007). The revised TRA, the theory of planned behaviour (TPB), included perceived behavioural control which takes into account perceived obstacles to performing the behaviour and therefore, the TPB provides an additional explanation for the findings of the current study. Young Asian's hold a more positive attitude towards PE but demonstrate lower levels of activity because they have perceived obstacles to performing the behaviour such as parental income, environment or additional domestic responsibilities. This would support previously published work which recognised the effect of income on participation in physical activity, exercise and sport (Collins, 2004; Shropshire and Carroll, 1997) and statistics which show that people from ethnic minority groups tend to live in low-income households (National Statistics Online, 2006; Sports Council, 1994). Findings can be related to the perception by such low-income families that the neighbourhoods in which they live are unsafe for young people to play in (Andersen et al., 1998), or indeed that members of the Asian community relegate the importance of structured physical activity behind other commitments including family life and religious duties (Sports Council, 1994).

Acculturation can also be used in an attempt to explain ethnic differences in attitudes. Acculturation has been defined as “the process by which individuals integrate the customs, attitudes, and habits associated with their traditional cultures with those of the dominant culture” (Kawamura, 2002: 247). Therefore, one individual from an ethnic minority group may associate more with the host or mainstream culture than their traditional culture because they are third or fourth generation British or because of their peer group or social life. Another individual may associate more with their traditional culture(s) as they are first generation British and English is not their first language. Subsequently, this will lead to considerable variability in young people’s attitudes and behaviours, which in turn impacts upon their health and well-being.

The proposed alternative model (Figure 16) is based upon the findings of the current study whilst considering Blair’s (1989) physical activity-health model and the theories of reasoned action (Ajzen and Fishbein, 1980) and planned behaviour (Ajzen, 1988). This proposed model incorporates the simultaneous effects of ethnicity, gender and school year upon the dependent variables of physical activity, attitude towards PE and health related fitness as well as the associations between physical activity and attitude towards PE, and health related fitness which have been explored in the current study (denoted by solid lines on the model).

The model also acknowledges hypothetical links between dependent and independent variables (denoted by dotted lines on the model). These hypothetical links are based upon published literature and existing models and concepts. As the current study has measured the strength of the relationship between physical activity and health related fitness only and not health, this link is expressed as a hypothetical one based upon Blair's physical-activity health model which hypothesised that childhood activity is associated with childhood health. Similarly, the current study has measured young people between the ages of 11 and 15 years, therefore, a life course approach has not been taken and the long-term effects on chronic disease risk of physical and social exposures during different points in the human lifetime (Ben-Shlomo and Kuh, 2002) have not been established. Subsequently, the association between childhood physical activity and health, and adult physical activity and health as represented in Blair's model, has not been confirmed.

It is, however, acknowledged that further research is required to add credence to the revised model. Additional work (and perhaps the development of different models) will add weight to the hypothetical links between attitude towards PE, physical activity and health related fitness. In addition, the current model only considers ethnicity, gender and school year whereas the effects of a broader range of factors on attitude towards PE, health-related fitness and physical activity are worth further consideration. Other socio-cultural and socio-economic factors warrant further exploration as do special populations including young people with disabilities and the obese.

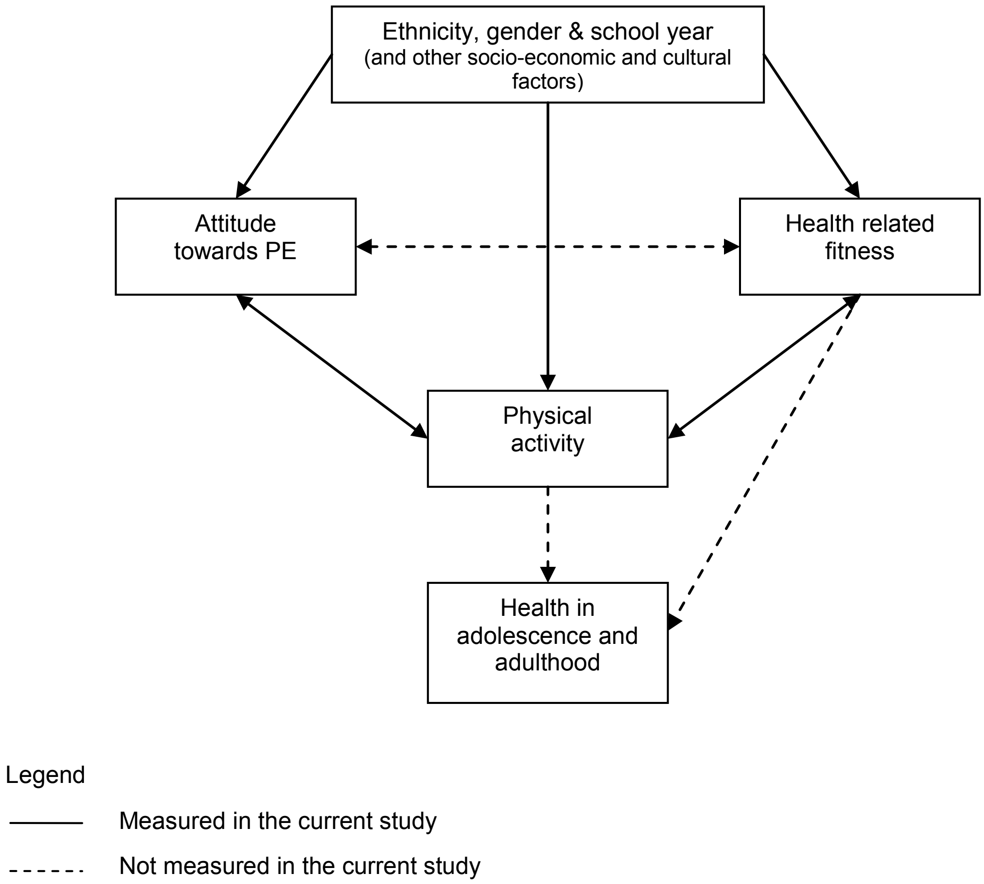

Figure 16. Model to show the factors influencing and interrelations between physical activity, attitude towards PE and health related fitness in young people.

5.5 Limitations of the current study

Although efforts were made to control for confounding variables and to ensure that all measurements were objective, the very nature of the current study (i.e. a school-based field study) has resulted in limitations in methodology and design. These will now be outlined.

Although a pilot study was carried out to ascertain whether it would be appropriate to administer the Four by One-day Physical Activity Recall Questionnaire to small groups of respondents, the questionnaire was originally designed and validated to be interviewer administered to one young person at a time. It must therefore be acknowledged that this may have had some impact upon the data obtained. However, in small peer groups, respondents were able to support each other to aid in the accuracy of recall; for example, how long they had actually participated in physical activity during the PE lesson and how much time was lost to activities such as changing, transfer to the practical space in which the lesson was being taught and the setting up of equipment. Moreover, completing the questionnaires in small groups with the support of year group peers made the young people feel at ease with the researcher and therefore, more likely to provide honest responses as opposed to socially desirable responses (particularly when questioned further by the interviewer).

Measures used to assess physical activity, attitude towards PE and health-related components of physical fitness were selected primarily for their appropriateness for use with young people. Both questionnaires, the Four by One-Day Recall (Cale, 1994) and the PAAPEQ (Shropshire and Carroll, 1997), had been previously designed for use with young Britons of a similar age to those participating in the current study. The various measures used to assess health-related fitness are also frequently used by both schools and researchers. However, it is important to note that these measures are doubly indirect (i.e. compared against existing indirect measures). For example, when originally designed, the concurrent validity of the Four by One-Day questionnaire was established against both heart rate monitoring and observation techniques as measures for assessing physical activity which are themselves based upon a number of assumptions. Similarly, the multistage fitness test does not provide a direct measure of cardiovascular fitness and the sit and reach test provides an indirect, linear measurement of flexibility. With particular reference to the multistage fitness test, it provides a predicted VO_{2peak} value based upon validation study data where cardiovascular endurance was assessed using a treadmill protocol and is of course dependent upon the participants willingness to run to their maximal.

Nevertheless, all measures have been selected to facilitate the measurement of physical activity, attitude towards PE, and the assessment of health-related fitness amongst large samples. If, for example, laboratory measures of fitness or a purely quantitative measure of physical activity (e.g. heart rate monitoring) had been employed, sample sizes would have been suppressed not only due to the time taken to use these methodologies but also due to the socially undesirable nature of the measures for use amongst young people in a school setting. However, there are implications of using field-based and less objective measures, such as self-report questionnaires, as the accuracy of data collected can be questioned.

Due to the nature of the present study, schools tended to provide access to their pupils during timetabled PE lessons. This may have been due to the function of individual school timetables and/or due to the willingness of PE staff as opposed to other members of teaching staff to participate in a study of this nature. Indeed, although the head teachers of participant schools were contacted and invited to take part in the current study, communication between school and the researcher tended to be delegated to a member of PE staff which may have had some influence upon the quality and accuracy of pupil responses. Although the interviewer assured the pupils that their responses would remain confidential, some pupils may have provided socially desirable responses because they thought their teachers would be privy to the information as questionnaires were completed during PE lessons. Therefore, some pupils may have reported that they had engaged in more activity than they had in reality (such as activities with a higher energy cost e.g. organised sport). In addition, for fear of teacher reprisal, pupils may have reported a more positive attitude towards PE.

Although both school staff and researcher liaised to organise times in which research was to be conducted, this was largely dictated by the schools' timetables and subsequently PE teaching time was used. This would have resulted in suppressed physical activity during the research period. Therefore, pupils' physical activity during the week of recall could be lower than a typical week when they would receive full PE provision. However, only part of the PE lesson would have been taken to complete a school day physical activity questionnaire, and, depending upon the activity being undertaken in the PE lesson, equivalent to approximately 15 minutes MVPA, or one kcal kg^{-1} day^{-1}.

As research was conducted in individual participant schools data collection took place at periods most suitable to the school. As a result some pupils did not have had normal activity patterns for the week of observation. Energy expenditure may have been atypical due to school events (e.g. changes to school timetable, extra curricular sporting events), or cultural and religious events (e.g. religious festivals such as Ramadan). Therefore, during the data collection period, individual pupils at participant schools either expended more or less energy than average. However, the questionnaire did provide pupils with the opportunity to state whether their physical activity patterns for the days recalled were typical or not. The effects of these issues upon the data collected are difficult to quantify although a test retest approach could be used to establish whether physical activity differs significantly between typical and atypical days. It is important to note that as all participants were randomly selected across school year, ethnic and gender groups and that data collection took place throughout the year no single sub group would have been disadvantaged or advantaged. It should also be acknowledged that some participants reported atypical activity patterns due to personal reasons such as illness, irregular family commitments and sporting commitments (e.g. whole day sporting event such as tournaments). However, in an attempt to limit the affect of seasonal changes in activity patterns, phase two took place at the same time of year as phase one and therefore, within subject changes were observed.

Another limitation relates to sampling procedures. Although effort was made to have approximately equal number of pupils in each of gender and year groups, final numbers for participants were not evenly balanced. For example, more girls than boys took part, school year groups were uneven. Subsequently, in some instances, results are reported for relatively small groups and this was more notable when considering cell sizes, i.e. when you divide ethnicity by school year and gender (the smallest cell size was seven black boys in Year C), and although schools were targeted in collaboration with the education authority because of the ethnic mix of their pupils, more white young people than both Asian and black young people participated in the study. However, white groups comprise the largest ethnic population group and therefore the proportion of white, black and Asian participants was broadly representative of Birmingham at the time of data collection (National Statistics Online 2006).

Due to the fact that pupils were given the choice whether to participate, those children who did not perceive themselves to be as active as their fellow year group peers may not have agreed to take part in the study. Therefore, data collected could have been skewed with a larger number of young people taking part in the current study who are more active than those who are inactive. Moreover, this skewing could have been more notable amongst the randomly selected sub-sample who participated in the health-related fitness testing. Therefore, pupils who did not want to take part for whatever reason (e.g. body size/stature, perceived inability to perform physical challenges etc) may have withdrawn from this element of the study. Thus, it is possible that those who participated in health-related fitness testing were more able and more active pupils who consequently possess greater levels of health-related fitness compared with their peers. However, analysis conducted to establish whether young people who participated in both phases of the study were representative of the original sample (including those who did not participate in phase two of the study) revealed no significant difference in energy expenditure, total attitude towards PE, and selected health-related fitness variables (i.e. cardiovascular fitness and measures of body composition);

5.6 Overview of hypotheses tested

The research hypotheses stated in section 1.8.1 have been either accepted or rejected based upon the findings of the current study.

H1 There is a difference in young people's physical activity according to ethnicity. This hypothesis has been accepted as statistically significant differences were revealed between the different ethnic groups.

H2 There is a difference in young people's physical activity according to gender. This hypothesis has again been accepted as girls were found to be significantly less active than boys.

H3 There is a difference in young people's physical activity according to school year. This hypothesis has been accepted as physical activity levels were found to decline significantly with school year.

H4 There is a difference in young people's physical activity over time. There is some support for this hypothesis as physical activity levels decreased significantly between data collections.

H5 There is a difference in young people's attitudes towards physical education according to ethnicity. With reference to the PE teacher factor of the PAAPEQ, a significant difference was found. However, this hypothesis has been rejected and the corresponding null hypothesis accepted because no further significant differences according to ethnicity were revealed.

H6 There is a difference in young people's attitudes towards physical education according to gender. This hypothesis has been rejected and the corresponding null hypothesis accepted because no significant differences according to gender were found. However, significant ethnicity by gender by time interactions were found indicating that the attitudes of black boys become more positive as they age.

H7 There is a difference in young people's attitudes towards physical education according to school year. This hypothesis has been accepted as attitudes towards PE were found to become significantly less favourable with age.

H8 There is a difference in young people's health related fitness according to ethnicity. Although some significant ethnic differences were found, these were inconsistent. Therefore, the research hypothesis has been rejected and the corresponding null hypothesis accepted.

H9 There is a difference in young people's health related fitness according to gender. Again, although some differences between boys and girls were found, these were inconsistent. Therefore, the research hypothesis has been rejected and the corresponding null hypothesis accepted.

H10 There is a difference in young people's health related fitness according to school year. Although some significant differences were found according to school year, the hypothesis has been rejected and the corresponding null hypothesis accepted as findings were inconclusive.

H11 There is a difference in young people's health related fitness over time. Although there is some support for the hypothesis as a number of the components measured changed over time, findings were inconclusive. Hence, the hypothesis has been rejected and the corresponding null hypothesis accepted.

H12 There is a relationship between young people's physical activity and attitudes towards physical education. This hypothesis has been accepted as some consistent significant relationships were revealed between physical activity variables and total attitude scores and the general interest factor. However, across data collections some inconsistent findings were made with reference to the remaining four factors and the physical activity variables.

H13 There is a relationship between young people's physical activity and health related fitness. This hypothesis has been rejected and therefore the corresponding null hypothesis accepted. Again, some significant relationships were revealed between physical activity variables and health related fitness variables but findings were not consistent across all variables and across data collections.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The aims of the current study were to assess the physical activity, attitude towards physical education, and health related fitness of young Britons according to ethnicity, school year and gender. The findings of this study have implications for future related research and for developing policies and interventions to improve the physical activity and health of young people from different ethnic groups.

The physical activity levels of young people in this study decreased with age. Energy expenditure and time spent in moderate and vigorous intensity activity declined over time (short-longitudinally) and with school year (cross-sectionally). Furthermore, percentages classified as active or moderately active decreased and numbers failing to meet desirable physical activity recommendations for young people (i.e. of 60minutes of accumulated physical activity of at least moderate intensity per day) increased with age. Therefore, there is the need to target interventions to arrest the decline in young people's physical activity during adolescence.

Young people from Asian ethnic minority groups were found to expend less energy and participate in less moderate and vigorous activity than white and black groups. In addition, three quarters of Asian pupils were categorised as inactive or very inactive and a higher percentage of Asian pupils than white and black pupils failed to meet desirable physical activity recommendations. Thus, interventions aimed specifically at increasing the physical activity levels of Asian pupils in British schools are required.

Girls were less active than boys. Girls expended less energy, engaged in less moderate and vigorous activity and had a lower percentage classified as either active or moderately active. Therefore, interventions to specifically target girls' physical activity habits are needed. However, as young people age, the physical activity gap between boys and girls is less marked.

Energy expenditure for school days was lower than for weekends. Thus, school-based interventions and initiatives aimed at enhancing physical activity levels throughout the school day are desirable as young people spend the majority of the week during the school term at school.

Generally, attitude towards PE became less favourable with age with younger pupils having more positive attitudes than older pupils. However, the attitudes of black boys towards PE became more positive with time. Therefore, school-based interventions and policies to foster more positive attitudes towards PE are required to somehow arrest the development of negative attitudes towards PE with age and to establish reasons for an increase in positive attitudes amongst black boys.

With particular reference to the PE teacher factor in the PAAPEQ, Asian pupils were found to have a less positive attitude towards their teachers than white and black pupils. In addition, with the exception of white pupils, boys have a more positive attitude to their PE teachers than girls. Initiatives to somehow redress the balance are desirable.

For both phases of data measurement, relationships were found between total attitude towards PE and s ome factors of the questionnaire and physical activity variables, however, findings were inconsistent across data measurements. Weak yet significant positive relationships were found for both data measurements between:

- total attitude towards PE and energy expenditure and vigorous activity
- general interest factor and energy expenditure, moderate activity and vigorous activity.

Therefore, Ajzen and Fishbein's (1989) theory of reasoned action was partially supported as young people who held more positive attitudes towards PE were more active. H owever, as previously mentioned correlations were weak, inconsistent and found in only a few PAAPEQ factors and therefore, the relative importance of attitudinal and n ormative components of the model need to be taken into consideration.

Although some differences in young people's health related fitness were found (e.g. age, ethnic and gender differences) these were inconsistent:

- height, weight, percent body fat, muscular strength and muscular endurance were found to increase with age – between both points of measurement and between different school years
- body mass index for boys decreased over time but values for girls remained relatively stable between both points of measurement
- percent body fat was higher for girls than boys
- cardiovascular endurance was higher for boys than girls

- cardiovascular endurance increased with school year for white and Asian pupils but decreased for black pupils
- flexibility, muscular endurance and muscular strength of black pupils was higher than for white and Asian groups.

Relationships between physical activity variables and health related fitness components were generally inconclusive and inconsistent. For only one health related fitness component, muscular endurance, the same findings were made for both points of measurement. Muscular endurance was found to be positively related to average daily energy expenditure and time spent in moderate and vigorous activity. Therefore, the findings of the current study cannot be used to support Blair's (1989) model hypothesising the link between childhood physical activity and health.

6.2 Recommendations for future related research

The present study has provided additional research into physical activity, attitude towards PE and health-related fitness of young Britons from various population groups. Additional future related research is required to build upon and provide further clarification for the findings made.

The focus of the current study has largely been quantitative involving almost four hundred randomly selected young people from six secondary schools across the City of Birmingham LEA. Therefore, it is advocated that future research take a more qualitative approach to provide explanations for the differences found between the different ethnicities, genders and age groups at British secondary schools. One advancement would be to identify individuals who are very active or inactive and to carry out interviews to establish why they engage in or do not engage in physical activity.

One of the limitations previously discussed was the sampling procedure used in the current study. Future research drawing from a larger, randomly selected sample would provide data more representative of a large multicultural city. In addition, greater use of objective measures of physical activity is required to elicit more information regarding the physical activity and health-related fitness levels of young people from different ethnic groups.

The current study has been conducted in a West Midlands LEA. Therefore, future related studies conducted in different LEAs around the British Isles could ascertain whether the findings of the present study reflect those of the Nation. Similarly, all the schools that participated in the present study were based in either inner city or urban communities within the City of Birmingham LEA. Future comparative studies between schools in these areas with rural or indeed extra urban communities should be carried out. Therefore, agencies can compare young people's activity patterns according to their local environment and establish with greater confidence interventions to increase activity levels.

It has not been the remit of the current study to establish the socio-economic background of participants, however, literature and statistics indicate that ethnic minority groups are more likely to be stratified into lower socio-economic groups and live in homes with a low income (Sports Council, 1994; National Statistics Online, 2006). Therefore, from a public health perspective, research into the simultaneous effects of ethnicity and socio-economic background on young people's physical activity levels is needed.

The current study is short-longitudinal in design, having tracked pupils over a relatively short timescale (twelve months). It has previously been reported that physical activity levels remain relatively consistent over time and that inactive children become inactive adults (Janz et al, 2002; Pate et al, 1999). Therefore, future research monitoring physical activity and fitness levels over longer durations (from childhood into adolescence and through to adulthood) would be advantageous. In addition to providing data regarding the longitudinal development of physical activity, additional information pertaining to the type of activity undertaken following the end of compulsory physical education and school sport should be gathered. Moreover, the longitudinal effects of physical activity on health and fitness could also be established.

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Appendix I
Letter of consent from Birmingham Local Education Authority

Content removed on data protection grounds

Appendix II
Sample letter inviting head teachers to take part in phase one of the study

Dear ______________,

I am a postgraduate research student studying at Newman College of Higher Education, Birmingham looking at the relationship between lifestyle, physical activity and health of children in the City of Birmingham. Permission has been granted by the Chief Education Officer, Prof. Brighouse, to conduct the study in secondary schools within Birmingham LEA and a letter has been received to confirm this.

Recent research indicates that certain child population groups are possibly less active than others. The Health Education Authority has identified children of minority and ethnic backgrounds and adolescent girls as requiring further research.

I would like to explore the possibility of including some of the children from ________________ Secondary School in the selected sample and believe that this research should benefit those involved in the area of education and health. All information gathered throughout the study will be treated with strict confidentiality. I would like to arrange a meeting with you, to discuss the research in further detail and if you are interested in your school being involved in the study you can contact me at the above number or by email - l.a.woodfield@newman.ac.uk.

Yours sincerely

Lorayne Woodfield

Appendix III
Sample informed consent letter sent to parents/legal guardians for phase one of the study

Dear Parent/Guardian,

I am a student from Newman College in Birmingham and I am interested in carrying out a study into children's physical activity. ____________________ School has kindly agreed to participate in the study and I am therefore writing to ask for your permission to allow your child to take part in the study.

The children involved in the study will be asked to complete a questionnaire about their daytime activities. The research should not interfere with your child's schoolwork or everyday activities in anyway.

If you agree to your child being involved, please could you fill in the form below and return it to school as soon as possible.

Thank you very much for your co-operation

Lorayne Woodfield

....

I give permission for my son/daughter ________________________________

to be involved in the study.

I understand that the results of the study will be completely confidential and my child can withdraw from the study at any time if he/she wishes.

____________________________ (parent/guardian) __________ (date)

Appendix IV
Sample letter inviting head teachers to take part in phase two of the study

Dear _____________,

I am a postgraduate research student at Newman College and last year _____________ School kindly agreed to participate in research looking at the relationship between lifestyle, physical activity and health of children in the City of Birmingham. Permission has been granted by the Chief Education Officer, Prof. Brighouse, to conduct the study in secondary schools within Birmingham LEA.

Last year I worked with some of your year 7, 8 and 9 pupils. Now that the participants are one year older, I would like to continue my research with these pupils. I remind you that all information gathered throughout the study will be treated with strict confidentiality. I would appreciate it if you could contact me on the above number or by email (l.a.woodfield@newman.ac.uk) to discuss this further.

Yours sincerely

Lorayne Woodfield

Appendix V
Sample informed consent letter sent to parents/legal guardians for phase two of the study

Dear Parent/Guardian,

I am a postgraduate research student at Newman College and last year ___________ School kindly allowed me to conduct research with some pupils from years 7, 8 and 9. Your son/daughter was one of the participants who took part in a survey into young people's physical activity and fitness.

Now that the participants are one year older, your son/daughter will be again asked to complete a questionnaire about their daytime activities. The research should not interfere with your child's schoolwork or everyday activities in anyway.

If you agree to your child being involved, please could you fill in the form below and return it to school as soon as possible.

Thank you very much for your co-operation

Lorayne Woodfield

....

Research into young people's physical activity and fitness

I give permission for my son/daughter ______________________________

to be involved in the study.

I understand that the results of the study will be completely confidential and my child can withdraw from the study at any time if he/she wishes.

____________________________ (parent/guardian) _________ (date)

Appendix VI
Four by one-day physical activity recall questionnaire: school day form

PART ONE-IN THE MORNING

1) **What time did you get up yesterday?**

☐☐☐☐ a.m.

2) **How did you get to school yesterday?**
(Just report the main method of how you got there).

WALK	☐
BUS	☐
CAR	☐
CYCLE	☐
OTHER (If other, what was it?)	☐

3) **How long did the journey take?**

☐☐ minutes

IN THE MORNING

YESTERDAY MORNING BEFORE SCHOOL

4) Did you do any of these activities?

watched television	❑
listened to music	❑
talked with friends	❑

5) Did you do any light household chores, wash-up, tidy-up etc.?
If so, for how long?

		TOTAL TIME hours	minutes
light household chores	❑	❑	❑❑

6) Did you do any of these activities? If so, for how long?
Did you "huff and puff?"

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
played football in the playground	❑	❑	❑❑	❑	❑
played other ball games in the playground	❑	❑	❑❑	❑	❑
played tag/chasing games in the playground	❑	❑	❑❑	❑	❑

7) Any other activity?
If so, What?

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
______________________	❑	❑	❑❑	❑	❑

AT SCHOOL

8) Was yesterday a P.E. day?

YES ☐
NO ☐

9) If yes, did you do any of these activities?

(If no, go to Q 11 on next page)

	TOTAL TIME hours	minutes		"HUFF AND PUFF?" Yes	No
swimming	☐	☐	☐☐	☐	☐
netball	☐	☐	☐☐	☐	☐
hockey	☐	☐	☐☐	☐	☐
gymnastics	☐	☐	☐☐	☐	☐
rounders	☐	☐	☐☐	☐	☐
basketball	☐	☐	☐☐	☐	☐
athletics	☐	☐	☐☐	☐	☐
football	☐	☐	☐☐	☐	☐
rugby	☐	☐	☐☐	☐	☐

10) Any other activity?
If so, what?

__________________ ☐ ☐ ☐☐ ☐ ☐

AT BREAK TIME

11)

talked with friends	☐
played card or board games	☐
listened to music	☐

12)

		TOTAL TIME			"HUFF AND PUFF?"	
		hours	minutes		Yes	No
played football in the playground	☐	☐	☐☐		☐	☐
played other ball games in the playground	☐	☐	☐☐		☐	☐
played tag/chasing games in the playground	☐	☐	☐☐		☐	☐

13) Any other activity?
If so, What?

________________________	☐	☐	☐☐		☐	☐

AT LUNCH TIME

14)

talked with friends	☐
played card or board games	☐
listened to music	☐

15)

		TOTAL TIME hours	minutes
walked to the shop	☐	☐	☐☐
walked home for lunch	☐	☐	☐☐

16

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
played football in the playground	☐	☐	☐☐	☐	☐
played other ball games in the playground	☐	☐	☐☐	☐	☐
played tag/chasing games in the playground	☐	☐	☐☐	☐	☐

17)

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
swimming	☐	☐	☐☐	☐	☐
netball	☐	☐	☐☐	☐	☐
hockey	☐	☐	☐☐	☐	☐
gymnastics	☐	☐	☐☐	☐	☐
rounders	☐	☐	☐☐	☐	☐
basketball	☐	☐	☐☐	☐	☐
athletics	☐	☐	☐☐	☐	☐
football	☐	☐	☐☐	☐	☐
rugby	☐	☐	☐☐	☐	☐

18) Any other activity?
If so, What?

______________________	☐	☐	☐☐	☐	☐

PART TWO-IN THE AFTERNOON

AFTERNOON BREAK TIME (if the subject does not have an afternoon break go to Q 22).

19)

talked with friends ☐
played card or board games ☐
listened to music ☐

20)

		TOTAL TIME		"HUFF AND PUFF?"	
		hours	minutes	Yes	No
played football in the playground	☐	☐	☐☐	☐	☐
played other ball games in the playground	☐	☐	☐☐	☐	☐
played tag/chasing games in the playground	☐	☐	☐☐	☐	☐

21) Any other activity?
If so, What?

________________________ ☐ ☐ ☐☐ ☐ ☐

PART THREE-AFTER SCHOOL/ IN THE EVENING

22)

talked with friends	❑
played card or board games	❑
listened to music	❑

23)

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
played football in the playground	❑	❑	❑❑	❑	❑
played other ball games in the playground	❑	❑	❑❑	❑	❑
played tag/chasing games in the playground	❑	❑	❑❑	❑	❑

24) How did you get home from school yesterday?
(Just report the main method of how you got home).

WALK	❑
BUS	❑
CAR	❑
CYCLE	❑
OTHER (If other, what was it?)	❑

25) How long did the journey take?

❑❑ minutes

26) Any other activity?
If so, What?

__________________________ ❑ ❑ ❑❑ ❑ ❑

IN THE EVENING

27)

watched television	☐
watched videos	☐
listened to music	☐
played card or board games	☐
played with toys	☐
drew or painted	☐
played a musical instrument	☐
used a computer/played computer games	☐
homework	☐
read for pleasure	☐

28)

		TOTAL TIME hours	minutes
cared for pets	☐	☐	☐☐
light household chores, wash-up, tidy-up etc.	☐	☐	☐☐
went for a walk/stroll	☐	☐	☐☐
did a part-time job	☐	☐	☐☐
went to a youthclub or disco	☐	☐	☐☐

IN THE EVENING

29)

		TOTAL TIME		"HUFF AND PUFF?"	
		hours	minutes	Yes	No
clean/hoover or move furniture	☐	☐	☐☐	☐	☐
gardening	☐	☐	☐☐	☐	☐
brisk walking	☐	☐	☐☐	☐	☐
did a paper round	☐	☐	☐☐	☐	☐
cycle	☐	☐	☐☐	☐	☐
golf	☐	☐	☐☐	☐	☐
swimming	☐	☐	☐☐	☐	☐
tennis	☐	☐	☐☐	☐	☐
badminton	☐	☐	☐☐	☐	☐
hockey	☐	☐	☐☐	☐	☐
gymnastics	☐	☐	☐☐	☐	☐
volleyball	☐	☐	☐☐	☐	☐
netball	☐	☐	☐☐	☐	☐
basketball	☐	☐	☐☐	☐	☐
athletics	☐	☐	☐☐	☐	☐
running	☐	☐	☐☐	☐	☐
football	☐	☐	☐☐	☐	☐
rugby	☐	☐	☐☐	☐	☐
disco dancing	☐	☐	☐☐	☐	☐

30) Any other activity?
If so, What?

______________________________ ☐ ☐ ☐☐ ☐ ☐

31) What time did you go to bed yesterday?

☐☐☐☐ p.m.

32) Was yesterday a typical day for you?

YES ☐

NO ☐

If no, why not?

____

Appendix VII
Four by one-day physical activity recall questionnaire: weekend form

PART ONE-IN THE MORNING

1) What time did you get up on Saturday/Sunday?

☐☐☐☐ a.m.

2) Did you do any of these activities?

watched television	☐
watched videos	☐
listened to music	☐
played card or board games	☐
played with toys	☐
drew or painted	☐
played a musical instrument	☐
used a computer/played computer games	☐
homework	☐
read for pleasure	☐

3) Did you do any of these activities?
If so, for how long?

		TOTAL TIME hours	TOTAL TIME minutes
cared for pets	☐	☐	☐☐
light household chores, wash-up, tidy-up etc.	☐	☐	☐☐
went for a walk/stroll	☐	☐	☐☐
did a part-time job	☐	☐	☐☐
went to a youthclub or disco	☐	☐	☐☐

IN THE MORNING

4) Did you do any of these activities?
If so, for how long? Did you "huff and puff?"

	TOTAL TIME hours	TOTAL TIME minutes	"HUFF AND PUFF?" Yes	"HUFF AND PUFF?" No
clean/hoover or move furniture	☐ ☐	☐☐	☐	☐
gardening	☐ ☐	☐☐	☐	☐
brisk walking	☐ ☐	☐☐	☐	☐
did a paper round	☐ ☐	☐☐	☐	☐
cycle	☐ ☐	☐☐	☐	☐
golf	☐ ☐	☐☐	☐	☐
swimming	☐ ☐	☐☐	☐	☐
tennis	☐ ☐	☐☐	☐	☐
badminton	☐ ☐	☐☐	☐	☐
hockey	☐ ☐	☐☐	☐	☐
gymnastics	☐ ☐	☐☐	☐	☐
volleyball	☐ ☐	☐☐	☐	☐
netball	☐ ☐	☐☐	☐	☐
basketball	☐ ☐	☐☐	☐	☐
athletics	☐ ☐	☐☐	☐	☐
running	☐ ☐	☐☐	☐	☐
football	☐ ☐	☐☐	☐	☐
rugby	☐ ☐	☐☐	☐	☐
disco dancing	☐ ☐	☐☐	☐	☐

5) Any other activity?
If so, What?

____________________________	☐ ☐	☐☐	☐	☐

PART TWO-IN THE AFTERNOON

6)

watched television	☐
watched videos	☐
listened to music	☐
played card or board games	☐
played with toys	☐
drew or painted	☐
played a musical instrument	☐
used a computer/played computer games	☐
homework	☐
read for pleasure	☐

7)

		TOTAL TIME hours	TOTAL TIME minutes
cared for pets	☐	☐	☐☐
light household chores, wash-up, tidy-up etc.	☐	☐	☐☐
went for a walk/stroll	☐	☐	☐☐
did a part-time job	☐	☐	☐☐
went to a youthclub or disco	☐	☐	☐☐

IN THE AFTERNOON

8)

		TOTAL TIME hours	TOTAL TIME minutes	"HUFF AND PUFF?" Yes	"HUFF AND PUFF?" No
clean/hoover or move furniture	☐	☐	☐☐	☐	☐
gardening	☐	☐	☐☐	☐	☐
brisk walking	☐	☐	☐☐	☐	☐
did a paper round	☐	☐	☐☐	☐	☐
cycle	☐	☐	☐☐	☐	☐
golf	☐	☐	☐☐	☐	☐
swimming	☐	☐	☐☐	☐	☐
tennis	☐	☐	☐☐	☐	☐
badminton	☐	☐	☐☐	☐	☐
hockey	☐	☐	☐☐	☐	☐
gymnastics	☐	☐	☐☐	☐	☐
volleyball	☐	☐	☐☐	☐	☐
netball	☐	☐	☐☐	☐	☐
basketball	☐	☐	☐☐	☐	☐
athletics	☐	☐	☐☐	☐	☐
running	☐	☐	☐☐	☐	☐
football	☐	☐	☐☐	☐	☐
rugby	☐	☐	☐☐	☐	☐
disco dancing	☐	☐	☐☐	☐	☐

9) Any other activity?
If so, What?

______________________________	☐	☐	☐☐	☐	☐

PART THREE-IN THE EVENING

10)

watched television	❑
watched videos	❑
listened to music	❑
played card or board games	❑
played with toys	❑
drew or painted	❑
played a musical instrument	❑
used a computer/played computer games	❑
homework	❑
read for pleasure	❑

11)

		TOTAL TIME hours	minutes
cared for pets	❑	❑	❑❑
light household chores, wash-up, tidy-up etc.	❑	❑	❑❑
went for a walk/stroll	❑	❑	❑❑
did a part-time job	❑	❑	❑❑
went to a youthclub or disco	❑	❑	❑❑

IN THE EVENING

12)

		TOTAL TIME hours	minutes	"HUFF AND PUFF?" Yes	No
clean/hoover or move furniture	☐	☐	☐☐	☐	☐
gardening	☐	☐	☐☐	☐	☐
brisk walking	☐	☐	☐☐	☐	☐
did a paper round	☐	☐	☐☐	☐	☐
cycle	☐	☐	☐☐	☐	☐
golf	☐	☐	☐☐	☐	☐
swimming	☐	☐	☐☐	☐	☐
tennis	☐	☐	☐☐	☐	☐
badminton	☐	☐	☐☐	☐	☐
hockey	☐	☐	☐☐	☐	☐
gymnastics	☐	☐	☐☐	☐	☐
volleyball	☐	☐	☐☐	☐	☐
netball	☐	☐	☐☐	☐	☐
basketball	☐	☐	☐☐	☐	☐
athletics	☐	☐	☐☐	☐	☐
running	☐	☐	☐☐	☐	☐
football	☐	☐	☐☐	☐	☐
rugby	☐	☐	☐☐	☐	☐
disco dancing	☐	☐	☐☐	☐	☐

13) Any other activity?
If so, What?

__________________________ ☐ ☐ ☐☐ ☐ ☐

14) What time did you go to bed on Saturday/Sunday?

☐☐☐☐ p.m.

15) Was Saturday/Sunday a typical day for you?

YES ☐

NO ☐

If no, why not?

____

Appendix VIII of photos of children completing questionnaires has been removed due to third party copyright. The unabridged version of the thesis can be viewed at the Lanchester Library, Coventry University

Appendix IX
Sample summary sheet for four by one-day physical activity recall questionnaire: school day form

SUMMARY SHEET-SCHOOLDAY FORM

SUBJECTS NO			1 card 1
SCHOOL	CD -1 G -2 L -3 CoL -4 HP -5 BP -6 R -7 HC -8 Ch -9 Fr -10 LE -11 LG -12 OLCS -13		6 7
SUBJECTS AGE			8 9
BOY		1	10
GIRL		2	
TIME OF YEAR	WINTER	1	11
	SUMMER	2	
DAY OF WEEK	TUESDAY	1	12
	WEDNESDAY	2	
	THURSDAY	3	
	FRIDAY	4	
TIME SUBJECT GOT UP		a.m.	13 14 15 16
TIME SUBJECT WENT TO BED		p.m.	17 18 19 20
HOURS SLEEP	converted to minutes =	minutes	21 22 23
WAS THE DAY TYPICAL FOR THE SUBJECT?	YES	1	24
	NO	2	
IF NO, WHY NOT?			25
			26
			27

SUMMARY SHEET-PAGE 2

VERY LIGHT ACTIVITIES Please list all codes for very light activities the subject reported.

☐☐	28 29
☐☐	30 31
☐☐	32 33
☐☐	34 35
☐☐	36 37
☐☐	38 39

LIGHT ACTIVITIES Please list all codes for light activities the subject reported and the total time spent in each.

	TOTAL TIME minutes		
☐☐	☐☐☐	40 41	42 43 44
☐☐	☐☐☐	45 46	47 48 49
☐☐	☐☐☐	50 51	52 53 54
☐☐	☐☐☐	55 56	57 58 59
☐☐	☐☐☐	60 61	62 63 64
☐☐	☐☐☐	65 66	67 68 69
☐☐	☐☐☐	70 71	72 73 74

Please calculate total time spent in light activities.

TOTAL TIME = ☐☐☐ mins 75 76 77

SUMMARY SHEET-PAGE 3

card 2

MODERATE ACTIVITIES

Please list all codes for moderate/hard /very hard activities the subject reported, the total time spent in each and whether the activity/ies made the subject 'huff and puff'.

	TOTAL TIME minutes	'HUFF AND PUFF' Y=YES(1) N=NO(2)	
□□	□□□	□	6 7 / 8 9 10 / 11
□□	□□□	□	12 13 / 14 15 16 / 17
□□	□□□	□	18 19 / 20 21 22 / 23
□□	□□□	□	24 25 / 26 27 28 / 29
□□	□□□	□	30 31 / 32 33 34 / 35
□□	□□□	□	36 37 / 38 39 40 / 41
□□	□□□	□	42 43 / 44 45 46 / 47

Total time in moderate activities= □□□ mins (48 49 50)

card 3

HARD ACTIVITIES

	minutes	Y or N	
□□	□□□	□	6 7 / 8 9 10 / 11
□□	□□□	□	12 13 / 14 15 16 / 17
□□	□□□	□	18 19 / 20 21 22 / 23

Total time in hard activities= □□□ mins (24 25 26)

VERY HARD ACTIVITIES

□□	□□□	□	27 28 / 29 30 31 / 32
□□	□□□	□	33 34 / 35 36 37 / 38
□□	□□□	□	39 40 / 41 42 43 / 44

Total time in very hard activities= □□□ mins (45 46 47)

WAS THE DAY A P.E. DAY? YES □ 1 NO □ 2 (48)

Appendix X
Sample summary sheet for four by one-day physical activity recall questionnaire: weekend form

SUMMARY SHEET-WEEKEND FORM

☐☐☐ 2
card 1

SUBJECT'S NO ☐☐☐

SCHOOL				
	CD	-1		
	G	-2		
	L	-3		
	CoL	-4		
	HP	-5	☐☐	6 7
	BP	-6		
	R	-7		
	HC	-8		
	Ch	-9		
	Fr	-10		
	LE	-11		
	LG	-12		
	OLCS	-13		

SUBJECT'S AGE ☐☐ — 8 9

BOY ☐ 1
GIRL ☐ 2 — 10

TIME OF YEAR WINTER ☐ 1
SUMMER ☐ 2 — 11

DAY OF WEEK SATURDAY ☐ 1
SUNDAY ☐ 2 — 12

TIME SUBJECT GOT UP ☐☐☐☐ a.m. — 13 14 15 16

TIME SUBJECT WENT TO BED ☐☐☐☐ p.m. — 17 18 19 20

HOURS SLEEP converted to minutes = ☐☐☐ minutes — 21 22 23

WAS THE DAY TYPICAL FOR THE SUBJECT? YES ☐ 1
NO ☐ 2 — 24

IF NO, WHY NOT?
______________________ 25
______________________ 26
______________________ 27

SUMMARY SHEET-PAGE 2

VERY LIGHT ACTIVITIES

Please list all codes for very light activities the subject reported.

Code	Columns
☐☐	28 29
☐☐	30 31
☐☐	32 33
☐☐	34 35
☐☐	36 37
☐☐	38 39

LIGHT ACTIVITIES

Please list all codes for light activities the subject reported and the total time spent in each.

Code	TOTAL TIME minutes	Columns (code)	Columns (time)
☐☐	☐☐☐	40 41	42 43 44
☐☐	☐☐☐	45 46	47 48 49
☐☐	☐☐☐	50 51	52 53 54
☐☐	☐☐☐	55 56	57 58 59
☐☐	☐☐☐	60 61	62 63 64
☐☐	☐☐☐	65 66	67 68 69
☐☐	☐☐☐	70 71	72 73 74

Please calculate total time spent in light activities.

TOTAL TIME = ☐☐☐ mins — 75 76 77

SUMMARY SHEET-PAGE 3

card 2

MODERATE ACTIVITIES

Please list all codes for moderate/hard /very hard activities the subject reported, the total time spent in each and whether the activity/ies made the subject 'huff and puff'.

	TOTAL TIME minutes	'HUFF AND PUFF' Y=YES (1) N=NO (2)		
☐☐	☐☐☐	☐	6 7 / 8 9 10	11
☐☐	☐☐☐	☐	12 13 / 14 15 16	17
☐☐	☐☐☐	☐	18 19 / 20 21 22	23
☐☐	☐☐☐	☐	24 25 / 26 27 28	29
☐☐	☐☐☐	☐	30 31 / 32 33 34	35
☐☐	☐☐☐	☐	36 37 / 38 39 40	41
☐☐	☐☐☐	☐	42 43 / 44 45 46	47

Total time in moderate activities= ☐☐☐ mins (48 49 50)

HARD ACTIVITIES

card 3

	minutes	Y or N		
☐☐	☐☐☐	☐	6 7 / 8 9 10	11
☐☐	☐☐☐	☐	12 13 / 14 15 16	17
☐☐	☐☐☐	☐	18 19 / 20 21 22	23

Total time in hard activities= ☐☐☐ mins (24 25 26)

VERY HARD ACTIVITIES

☐☐	☐☐☐	☐	27 28 / 29 30 31	32
☐☐	☐☐☐	☐	33 34 / 35 36 37	38
☐☐	☐☐☐	☐	39 40 / 41 42 43	44

Total time in very hard activities= ☐☐☐ mins (45 46 47)

Appendix XI
Pre-adolescent attitude towards physical education questionnaire (PAAPEQ)

Attitude towards PE Questionnaire

Please answer *all* the questions.

Tick the box on the scale that most represents your opinion about each statement.

Questions	Very true	Sort of true	Not really true	Not at all true
I would like it if we had more PE lessons				
I would rather have PE than any other subject at school				
I feel cross if I have to miss PE				
I wish we did not have to do PE at school				
I think PE is fun				
Even when I do not feel well I still want to do PE				
I think PE is an important school subject				
PE will help me enjoy life when I leave school				
PE will help me to relax after I have been in the classroom				
I would like my teacher to test my knowledge by asking me questions				
A written test would be a good way of showing what I know				
I think other pupils should give me a grade in PE lessons				
I would like my PE teacher to give me a grade in PE lessons				
Girls and boys are treated the same by my PE teacher				
My PE teacher is kind and helpful even when we get things wrong				
The best players are given more responsibility by my PE teacher				
PE is boring because we always do the same things				
I do not like the activities in PE that make me tired and sweaty				
I would rather miss PE when it is cold and wet and we have to go outside				
Other pupils are often horrible to each other in PE lessons				
I hate having to change into PE kit				
I would like to choose whether we have PE inside or outside				
I would like PE more if we could wear what kit we wanted				

Appendix XII
Profile sheet used to record the health related fitness test data

NEWMAN COLLEGE OF HIGHER EDUCATION
Department of Physical Education and Sports Studies
Physiological Profile

Name:	DOB:	Gender:

Height: (cm)	Weight: (kg)	BMI:

Sit and Reach (cm)	1st	2nd	best

Grip strength(cm) Dominant hand	1st	2nd	best
Grip strength(cm) Non-Dominant hand	1st	2nd	best

Body Composition (mm)	Tri	Tri	
	Calf	Calf	

Sit ups (30 seconds)	

Shuttle Run	Level	Shuttle	VO_2 Max

Appendix XIII
Printout of SPSS data editor of raw data

yr	race	sex	wd1met	wd2met	satmet	sunmet	avemet	wd1moc	wd2moc	satmod	sunmod	avemod	wd1vig	wd2vig	satvig	sunvig	avevig	d1	d2	d3	d4	d5	totalat	height	weight	bmi	gdom	gnon	ssr	sups	msft	tri	calf	bf	vo2
8	3	2	35.3	33.9	41.2	35.3	36.4	30.0	30.0	235.0	50.0	86.3	0.0	0.0	0.0	0.0	0.0	34.0	13.0	11.0	12.0	3.0	73.0												
8	1	1	33.3	56.9	54.7	38.7	45.9	30.0	90.0	0.0	10.0	32.5	0.0	150.0	180.0	60.0	97.5	25.0	8.0	11.0	9.0	2.0	55.0												
8	1	1	45.6	42.5	60.8	39.0	47.0	330.0	260.0	0.0	120.0	177.5	0.0	0.0	150.0	0.0	37.5	32.0	10.0	5.0	14.0	4.0	65.0	163.0	56.0	21.1	27.7	24.2	25.0	29.0	8.2	16.0	14.4	23.0	40.5
9	3	2	36.4	32.3	34.0	34.9	34.4	80.0	0.0	60.0	90.0	57.5	0.0	0.0	0.0	0.0	0.0	23.0	14.0	12.0	10.0	3.0	62.0												
7	2	1	35.7	36.9	41.1	35.1	37.2	0.0	75.0	75.0	45.0	48.8	30.0	15.0	60.0	0.0	26.3	27.0	12.0	13.0	13.0	4.0	69.0	147.0	37.0	17.1	16.8	15.9	28.0	24.0	8.0	10.0	8.4	14.2	39.9
9	1	2	34.7	34.2	36.0	35.3	35.0	0.0	40.0	50.0	50.0	35.0	0.0	0.0	0.0	20.0	5.0	26.0	15.0	15.0	13.0	7.0	76.0												
7	1	2	33.2	33.2	35.7	34.0	34.0	30.0	20.0	90.0	75.0	53.8	10.0	0.0	0.0	0.0	2.5	31.0	12.0	13.0	12.0	6.0	74.0												
7	1	2	35.6	33.3	39.8	35.5	36.0	25.0	30.0	30.0	90.0	43.8	15.0	0.0	30.0	0.0	11.3	19.0	10.0	10.0	10.0	4.0	53.0												
9	1	1	31.3	34.9	43.6	36.1	36.5	0.0	60.0	265.0	90.0	103.8	0.0	0.0	0.0	0.0	0.0	11.0	7.0	10.0	14.0	2.0	44.0												
8	1	2	36.1	37.9	67.0	46.1	46.8	10.0	45.0	0.0	20.0	18.8	70.0	90.0	480.0	330.0	242.5	35.0	14.0	14.0	9.0	5.0	77.0	162.0	54.0	20.6	16.2	15.1	17.0	15.0	6.4	21.4	19.6	30.1	34.3
9	1	2	33.2	32.3	45.3	32.0	35.7	0.0	0.0	330.0	0.0	82.5	0.0	0.0	0.0	0.0	0.0	21.0	6.0	15.0	12.0	7.0	61.0												
8	3	1	35.8	31.8	40.4	35.5	35.9	0.0	0.0	0.0	180.0	45.0	60.0	0.0	60.0	0.0	30.0	29.0	13.0	14.0	5.0	2.0	63.0												
9	3	2	33.7	34.5	34.0	32.9	33.8	20.0	30.0	95.0	45.0	47.5	0.0	0.0	0.0	0.0	0.0	27.0	10.0	12.0	14.0	3.0	66.0												
9	3	2	34.6	32.3	40.0	32.8	34.9	30.0	0.0	100.0	5.0	33.8	0.0	0.0	0.0	0.0	0.0	21.0	13.0	8.0	8.0	2.0	52.0												
7	1	2	31.8	33.4	34.2	30.6	32.5	0.0	0.0	10.0	0.0	2.5	0.0	0.0	30.0	0.0	7.5	17.0	7.0	11.0	9.0	3.0	47.0	166.0	67.0	24.3	23.0	19.6	22.0	16.0	4.0	26.4	23.8	35.6	26.8
8	1	2	33.8	36.4	38.3	42.0	37.6	30.0	0.0	0.0	180.0	52.5	10.0	0.0	0.0	0.0	2.5	34.0	9.0	15.0	15.0	2.0	75.0	156.0	40.0	16.4	15.9	16.1	28.0	14.0	5.4	8.8	13.4	18.5	31.0
7	3	2	32.9	33.3	33.3	33.3	33.2	10.0	25.0	80.0	70.0	46.3	0.0	0.0	0.0	0.0	0.0	33.0	11.0	6.0	9.0	3.0	62.0												
7	3	2	31.5	33.5	34.0	34.0	33.3	10.0	35.0	45.0	80.0	42.5	0.0	0.0	0.0	0.0	0.0	31.0	15.0	13.0	13.0	8.0	80.0												
7	3	2	33.3	35.0	38.9	32.5	34.9	30.0	60.0	190.0	60.0	85.0	0.0	0.0	0.0	0.0	0.0	36.0	16.0	9.0	10.0	2.0	73.0												
7	3	2	35.0	35.1	64.1	45.3	44.9	5.0	0.0	360.0	300.0	166.3	0.0	30.0	180.0	0.0	52.5	35.0	10.0	14.0	13.0	5.0	77.0												
7	3	2	33.6	33.5	39.8	42.7	37.4	30.0	20.0	110.0	240.0	100.0	0.0	0.0	0.0	0.0	0.0	35.0	14.0	14.0	16.0	2.0	81.0												
7	3	2	33.8	40.8	32.8	31.8	34.8	30.0	0.0	60.0	30.0	30.0	0.0	60.0	0.0	0.0	15.0	33.0	12.0	9.0	16.0	3.0	73.0	137.5	25.0	13.3	9.2	8.3	32.0	15.0	4.0	9.0	8.2	15.5	26.8
9	1	1	34.9	34.8	38.0	34.2	35.5	60.0	60.0	100.0	80.0	75.0	0.0	0.0	10.0	0.0	2.5	26.0	10.0	10.0	12.0	5.0	63.0	166.0	54.0	19.6	35.0	35.7	33.0	23.0	8.2	12.6	13.8	20.1	40.5
7	2	1	39.8	40.0	35.4	32.2	36.8	105.0	125.0	60.0	45.0	83.8	55.0	45.0	30.0	0.0	32.5	30.0	12.0	9.0	9.0	4.0	64.0	150.5	55.0	24.4	20.4	21.9	30.0	26.0	4.2	26.2	20.2	34.8	26.8
8	1	1	34.7	46.2	56.3	37.1	43.6	115.0	80.0	90.0	165.0	112.5	0.0	120.0	60.0	0.0	45.0	35.0	13.0	12.0	15.0	2.0	77.0	157.0	52.0	21.1	22.8	18.9	20.0	22.0	5.4	10.5	17.0	21.6	31.0
7	3	2	39.0	36.6	56.3	37.3	42.3	120.0	90.0	375.0	95.0	170.0	0.0	0.0	70.0	0.0	17.5	32.0	15.0	15.0	13.0	8.0	83.0												
9	1	1	38.3	37.6	32.6	41.0	37.4	30.0	120.0	15.0	180.0	86.3	60.0	0.0	0.0	0.0	15.0	24.0	12.0	11.0	6.0	5.0	58.0												
9	3	2	33.5	31.0	35.9	29.7	32.5	30.0	0.0	60.0	0.0	22.5	0.0	0.0	0.0	0.0	0.0	33.0	11.0	12.0	10.0	2.0	68.0												
7	3	2	32.1	32.6	37.0	37.3	34.8	15.0	25.0	60.0	145.0	61.3	0.0	0.0	35.0	0.0	8.8	27.0	15.0	12.0	14.0	4.0	72.0												
9	3	2	30.8	31.3	33.1	33.5	32.1	0.0	0.0	45.0	45.0	22.5	0.0	0.0	0.0	0.0	0.0	32.0	9.0	9.0	10.0	2.0	62.0												
8	3	1	33.5	36.2	32.0	32.0	33.4	80.0	65.0	0.0	0.0	36.3	0.0	0.0	0.0	0.0	0.0	36.0	15.0	13.0	13.0	2.0	79.0	151.0	50.0	21.9	17.7	16.1	16.0	18.0	4.4	17.5	18.5	27.5	27.6
8	3	2	33.7	34.4	36.3	34.1	34.6	30.0	30.0	90.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	26.0	11.0	8.0	12.0	7.0	64.0												
7	3	2	37.1	36.4	37.6	34.3	36.3	60.0	75.0	110.0	70.0	78.8	0.0	0.0	30.0	0.0	7.5	28.0	11.0	8.0	12.0	3.0	62.0												
8	1	1	35.3	46.3	42.2	50.8	43.6	90.0	60.0	170.0	180.0	125.0	0.0	75.0	0.0	90.0	41.3	34.0	11.0	14.0	12.0	4.0	75.0	156.5	49.0	20.1	25.3	20.4	26.0	22.0	7.0	11.0	13.0	18.6	36.4
9	3	2	36.3	33.9	34.8	35.3	35.1	50.0	50.0	85.0	125.0	77.5	0.0	0.0	0.0	0.0	0.0	31.0	10.0	15.0	8.0	5.0	69.0	160.0	49.0	19.1	21.0	19.5	36.0	17.0	6.0	19.8	15.4	26.5	32.9
8	2	2	31.8	36.9	35.1	30.6	33.6	0.0	110.0	15.0	15.0	35.0	0.0	0.0	15.0	0.0	3.8	36.0	15.0	13.0	13.0	3.0	80.0												
7	1	1	32.1	31.9	48.5	43.6	39.0	0.0	0.0	390.0	0.0	97.5	0.0	0.0	0.0	90.0	22.5	36.0	9.0	9.0	9.0	2.0	65.0												
9	1	2	33.5	34.3	33.3	31.8	33.2	60.0	30.0	60.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	25.0	5.0	12.0	12.0	5.0	59.0	164.0	52.0	19.3	18.4	19.9	24.0	18.0	7.6	11.0	14.4	20.4	38.5
9	1	1	33.6	37.3	34.9	35.0	35.2	45.0	145.0	90.0	0.0	70.0	0.0	0.0	0.0	0.0	0.0	24.0	4.0	7.0	8.0	2.0	45.0	172.0	72.0	24.3	30.2	28.5	21.0	19.0	5.1	17.8	19.6	28.2	32.9
8	3	2	39.5	35.0	40.5	35.2	37.6	105.0	30.0	125.0	130.0	97.5	0.0	0.0	0.0	0.0	0.0	33.0	10.0	12.0	16.0	8.0	79.0												
8	1	1	40.9	33.0	33.0	30.3	34.3	0.0	30.0	30.0	0.0	15.0	60.0	0.0	0.0	0.0	15.0	32.0	8.0	11.0	12.0	3.0	66.0												
9	1	2	44.6	33.2	45.0	41.3	41.0	50.0	30.0	60.0	120.0	65.0	60.0	0.0	90.0	0.0	37.5	24.0	10.0	13.0	11.0	2.0	60.0												
9	1	2	34.0	34.0	31.2	33.7	33.2	0.0	0.0	10.0	60.0	17.5	0.0	0.0	0.0	0.0	0.0	19.0	7.0	11.0	8.0	2.0	47.0												
7	1	2	35.8	41.8	40.4	44.7	40.7	60.0	150.0	130.0	120.0	115.0	0.0	0.0	0.0	60.0	15.0	24.0	12.0	12.0	6.0	3.0	57.0												
7	1	1	34.0	43.8	50.2	44.5	43.1	0.0	210.0	265.0	120.0	148.8	0.0	0.0	30.0	30.0	15.0	30.0	10.0	14.0	14.0	2.0	70.0												
8	1	2	36.3	32.7	36.3	32.5	34.4	60.0	0.0	30.0	0.0	22.5	0.0	0.0	0.0	0.0	0.0	21.0	10.0	10.0	7.0	2.0	50.0	162.0	65.0	24.8	28.0	29.1	46.0	20.0	4.2	29.0	24.0	37.4	26.8
7	1	2	32.3	41.7	40.2	37.0	37.8	30.0	210.0	225.0	120.0	146.3	0.0	0.0	0.0	0.0	0.0	33.0	15.0	11.0	5.0	2.0	66.0												
8	1	2	32.5	34.5	41.3	34.8	35.8	0.0	60.0	60.0	300.0	105.0	0.0	0.0	0.0	0.0	0.0	23.0	6.0	13.0	9.0	2.0	53.0	165.0	56.0	20.6	24.1	22.3	28.0	19.0	4.2	31.4	25.6	39.9	26.8
9	2	2	31.8	31.2	32.6	33.5	32.3	0.0	0.0	20.0	60.0	20.0	0.0	0.0	0.0	0.0	0.0	30.0	15.0	14.0	12.0	3.0	74.0	153.0	42.0	17.9	13.9	10.6	35.0	16.0	5.0	13.0	12.6	21.0	29.5
9	1	2	32.5	34.4	39.6	49.8	39.1	0.0	0.0	30.0	120.0	37.5	0.0	0.0	0.0	90.0	22.5	31.0	10.0	9.0	14.0	2.0	66.0												
8	1	1	31.3	34.0	31.8	32.6	32.4	0.0	60.0	0.0	0.0	15.0	0.0	0.0	0.0	15.0	3.8	29.0	6.0	10.0	9.0	2.0	56.0												
7	1	1	40.9	33.2	39.3	35.5	37.2	100.0	40.0	180.0	150.0	117.5	30.0	0.0	0.0	0.0	7.5	31.0	14.0	14.0	10.0	3.0	72.0												
7	2	1	31.9	32.3	44.5	44.3	38.2	10.0	20.0	0.0	0.0	7.5	0.0	0.0	90.0	90.0	45.0	35.0	12.0	12.0	6.0	2.0	67.0												
7	1	1	40.8	32.3	47.2	51.3	42.9	0.0	10.0	380.0	120.0	127.5	60.0	0.0	0.0	90.0	37.5	34.0	11.0	15.0	9.0	3.0	72.0												
8	1	1	33.3	33.8	55.5	36.9	39.9	0.0	30.0	0.0	70.0	25.0	0.0	0.0	180.0	0.0	45.0	24.0	7.0	8.0	9.0	3.0	51.0												
7	2	2	31.6	33.3	40.1	34.5	34.9	0.0	30.0	40.0	10.0	20.0	0.0	0.0	25.0	15.0	10.0	32.0	11.0	14.0	15.0	8.0	80.0	165.0	55.0	20.2	21.4	22.5	37.0	20.0	4.4	14.4	12.4	21.6	54.8
9	1	2	39.6	36.1	46.1	51.8	43.4	90.0	40.0	205.0	260.0	148.8	20.0	0.0	0.0	0.0	5.0	29.0	8.0	15.0	10.0	3.0	65.0												
7	1	2	32.0	32.9	37.9	35.9	34.7	0.0	25.0	85.0	0.0	27.5	0.0	0.0	0.0	0.0	0.0	29.0	10.0	12.0	10.0	5.0	66.0	155.5	55.0	22.6	14.8	16.1	31.0	11.0	5.0	27.0	20.8	34.4	29.5
7	1	2	38.5	36.6	50.0	42.8	42.0	150.0	100.0	330.0	285.0	216.3	0.0	0.0	30.0	0.0	7.5	30.0	11.0	12.0	10.0	2.0	65.0	154.0	45.0	19.0	17.1	15.3	24.0	20.0	4.2	12.6	11.8	19.7	26.8
8	1	2	32.0	36.5	41.8	40.3	37.6	0.0	60.0	60.0	185.0	76.3	0.0	0.0	90.0	0.0	22.5	14.0	7.0	12.0	7.0	5.0	45.0	159.0	46.0	18.2	15.2	10.3	24.0	19.0	4.4	22.0	20.2	30.7	27.6
7	1	2	35.9	37.2	46.0	37.1	39.1	60.0	70.0	80.0	45.0	63.8	0.0	30.0	50.0	0.0	20.0	36.0	14.0	16.0	16.0	8.0	90.0	146.0	40.0	18.8	15.9	17.1	34.5	15.0	5.4	15.6	13.0	22.8	31.0
9	2	1	32.9	37.1	39.1	33.1	35.6	0.0	40.0	0.0	0.0	10.0	20.0	0.0	0.0	0.0	5.0	30.0	11.0	8.0	8.0	2.0	59.0												
9	3	1	34.5	46.9	38.3	36.3	39.0	0.0	60.0	90.0	150.0	75.0	0.0	85.0	0.0	0.0	21.3	27.0	9.0	11.0	6.0	3.0	56.0	155.0	56.0	23.3	26.0	25.0	32.0	25.0	6.6	23.0	19.8	33.0	35.0

9	1	2	32.3	31.8	54.5	41.2	39.9	0.0	0.0	180.0	310.0	122.5	0.0	0.0	120.0	0.0	30.0	28.0	7.0	15.0	12.0	3.0	65.0												
8	1	1	36.0	36.3	44.3	43.8	40.1	105.0	90.0	0.0	0.0	48.8	0.0	0.0	150.0	150.0	75.0	36.0	10.0	13.0	16.0	2.0	77.0												
7	1	1	34.8	35.1	51.0	56.6	44.4	60.0	75.0	285.0	165.0	146.3	0.0	0.0	75.0	120.0	48.8	35.0	8.0	10.0	14.0	3.0	70.0												
8	1	1	32.7	32.8	36.1	34.3	34.0	20.0	30.0	0.0	0.0	12.5	0.0	0.0	0.0	30.0	7.5	23.0	12.0	12.0	10.0	2.0	59.0												
8	1	1	35.0	45.8	44.4	46.2	42.8	70.0	100.0	270.0	40.0	120.0	0.0	80.0	0.0	90.0	42.5	31.0	14.0	10.0	15.0	6.0	76.0												
8	1	2	36.0	42.8	55.1	47.0	45.2	90.0	135.0	120.0	120.0	116.3	0.0	60.0	45.0	30.0	33.8	23.0	10.0	9.0	10.0	2.0	54.0	163.0	55.0	20.7	29.0	29.0	34.0	16.0	5.5	21.0	30.0	36.0	31.0
7	1	1	33.2	35.0	57.3	46.0	42.9	20.0	65.0	90.0	45.0	55.0	0.0	0.0	150.0	170.0	80.0	34.0	9.0	14.0	9.0	2.0	68.0												
7	1	1	32.1	31.9	42.2	38.0	36.1	15.0	10.0	0.0	85.0	27.5	0.0	0.0	75.0	15.0	22.5	30.0	10.0	12.0	15.0	4.0	71.0												
7	1	1	40.6	39.4	52.3	49.0	45.3	110.0	75.0	240.0	45.0	117.5	30.0	30.0	90.0	120.0	67.5	31.0	11.0	13.0	12.0	5.0	72.0												
7	1	1	36.3	37.3	57.1	43.8	43.6	30.0	30.0	60.0	120.0	60.0	0.0	0.0	150.0	120.0	67.5	32.0	14.0	13.0	15.0	3.0	77.0												
9	1	1	35.3	35.4	37.1	35.4	35.8	70.0	60.0	0.0	40.0	42.5	0.0	0.0	45.0	30.0	18.8	36.0	15.0	15.0	11.0	2.0	79.0	167.0	40.0	14.3	26.0	24.0	22.0	30.0	8.2	4.0	5.7	8.0	40.5
8	3	1	35.8	32.4	36.1	51.7	39.0	0.0	15.0	80.0	380.0	118.8	0.0	0.0	0.0	0.0	0.0	36.0	9.0	7.0	8.0	2.0	62.0	173.0	60.0	20.1	32.0	32.0	23.0	23.0	8.5	11.0	17.5	22.0	41.1
9	1	2	33.3	32.3	28.5	34.0	32.0	0.0	0.0	120.0	0.0	30.0	0.0	0.0	0.0	30.0	7.5	18.0	8.0	13.0	13.0	4.0	56.0												
8	3	1	32.0	33.0	39.9	32.8	34.4	0.0	30.0	160.0	30.0	55.0	0.0	0.0	0.0	0.0	0.0	33.0	10.0	15.0	11.0	2.0	71.0	149.0	57.0	25.7	11.0	13.0	10.0	12.0	7.6	18.0	22.0	30.0	38.5
9	2	2	33.0	35.5	32.0	47.1	36.9	0.0	60.0	0.0	260.0	80.0	0.0	0.0	0.0	0.0	0.0	13.0	6.0	11.0	10.0	2.0	42.0												
8	2	1	35.1	34.4	43.1	30.0	35.6	75.0	45.0	0.0	0.0	30.0	0.0	0.0	80.0	0.0	20.0	28.0	7.0	9.0	12.0	2.0	58.0	155.0	45.0	18.7	24.0	24.0	18.0	24.0	7.5	7.0	14.0	16.0	37.8
8	2	1	33.8	33.0	30.5	30.1	31.9	50.0	30.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	36.0	13.0	14.0	7.0	2.0	72.0												
7	3	2	32.4	32.3	34.1	32.7	32.9	0.0	0.0	30.0	0.0	7.5	0.0	0.0	0.0	20.0	5.0	29.0	11.0	12.0	12.0	3.0	67.0												
9	1	2	35.5	34.0	37.5	36.8	35.9	15.0	45.0	105.0	0.0	41.3	0.0	0.0	30.0	30.0	15.0	32.0	10.0	14.0	10.0	3.0	69.0												
8	1	2	34.7	43.0	38.6	31.6	37.0	10.0	90.0	110.0	45.0	63.8	30.0	90.0	20.0	0.0	35.0	33.0	10.0	14.0	7.0	2.0	66.0	143.0	30.0	14.7	13.0	14.0	30.0	20.0	4.2	19.0	15.8	27.0	26.8
9	1	2	34.4	34.5	32.2	36.3	34.3	30.0	10.0	0.0	135.0	43.8	0.0	10.0	0.0	0.0	2.5	25.0	9.0	9.0	7.0	3.0	53.0	160.5	48.0	18.8	29.0	24.0	17.0	19.0	5.4	20.0	17.2	28.0	31.0
7	1	2	39.5	32.3	41.5	36.0	37.3	0.0	0.0	50.0	120.0	42.5	0.0	0.0	70.0	0.0	17.5	28.0	13.0	13.0	6.0	2.0	62.0												
9	1	2	36.2	35.0	39.5	35.8	36.6	90.0	60.0	60.0	0.0	52.5	0.0	0.0	0.0	0.0	0.0	13.0	9.0	7.0	7.0	2.0	38.0												
9	3	2	33.8	32.8	33.8	34.3	33.6	0.0	0.0	45.0	60.0	26.3	0.0	0.0	0.0	0.0	0.0	18.0	6.0	9.0	9.0	2.0	44.0												
8	1	2	33.6	34.8	42.4	31.0	35.4	15.0	60.0	265.0	0.0	85.0	0.0	0.0	0.0	0.0	0.0	21.0	6.0	10.0	7.0	3.0	47.0	158.0	35.0	14.0	22.0	18.0	25.0	20.0	6.8	11.0	11.8	19.0	35.7
9	3	2	33.3	32.8	37.2	30.1	33.4	0.0	10.0	60.0	0.0	17.5	0.0	10.0	0.0	0.0	2.5	31.0	13.0	12.0	12.0	2.0	70.0												
9	3	2	30.5	30.8	35.6	37.3	33.5	0.0	0.0	20.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	35.0	10.0	12.0	13.0	5.0	75.0												
8	3	1	38.9	41.5	59.3	50.1	47.4	130.0	140.0	120.0	240.0	157.5	10.0	20.0	120.0	60.0	52.5	29.0	8.0	11.0	14.0	2.0	64.0	149.0	37.0	16.7	18.0	16.0	17.0	23.0	6.0	15.0	17.0	25.0	32.9
8	3	2	33.0	33.8	38.2	37.8	35.7	25.0	40.0	120.0	70.0	63.8	0.0	0.0	0.0	20.0	5.0	31.0	13.0	10.0	8.0	4.0	66.0												
9	3	1	31.8	36.4	34.8	32.6	33.9	0.0	105.0	60.0	45.0	52.5	0.0	0.0	0.0	0.0	0.0	16.0	5.0	12.0	9.0	4.0	46.0	171.0	53.0	18.1	28.0	26.0	19.0	19.0	5.9	24.0	19.2	33.0	32.9
9	3	2	35.2	32.9	34.4	31.3	33.5	40.0	0.0	25.0	15.0	20.0	0.0	0.0	0.0	0.0	0.0	23.0	10.0	10.0	12.0	5.0	60.0												
9	3	2	33.8	35.2	38.4	38.8	36.5	10.0	20.0	45.0	30.0	26.3	0.0	0.0	0.0	0.0	0.0	33.0	14.0	11.0	8.0	2.0	68.0												
9	2	2	36.6	33.8	49.9	39.5	39.9	30.0	0.0	150.0	90.0	67.5	0.0	15.0	60.0	30.0	26.3	36.0	12.0	13.0	10.0	8.0	79.0	151.5	61.0	26.8	25.0	26.0	28.0	18.0	3.8	20.0	18.8	28.0	26.8
7	3	2	31.2	31.0	32.1	31.1	31.3	0.0	0.0	75.0	20.0	23.8	0.0	0.0	0.0	0.0	0.0	25.0	7.0	9.0	9.0	6.0	56.0												
7	1	1	37.1	35.2	41.6	38.0	38.0	85.0	15.0	120.0	120.0	85.0	0.0	0.0	0.0	0.0	0.0	32.0	13.0	11.0	12.0	2.0	70.0												
8	3	1	44.3	35.6	39.8	36.5	39.0	70.0	60.0	0.0	0.0	32.5	60.0	0.0	60.0	0.0	30.0	36.0	15.0	12.0	13.0	2.0	78.0	166.0	49.0	17.8	24.0	21.0	4.0	27.0	5.9	17.0	18.5	27.0	32.9
8	1	1	43.9	53.1	49.9	50.0	49.2	70.0	90.0	100.0	120.0	95.0	60.0	120.0	90.0	90.0	90.0	24.0	10.0	8.0	11.0	5.0	58.0	151.0	38.0	16.7	25.0	21.0	15.0	24.0	9.0	7.0	8.2	13.0	43.3
8	1	1	33.9	32.7	42.3	41.6	37.6	55.0	45.0	0.0	0.0	25.0	0.0	0.0	90.0	90.0	45.0	30.0	12.0	10.0	11.0	4.0	67.0	152.0	48.0	20.8	13.0	14.0	6.0	16.0	5.4	18.0	18.5	28.0	31.0
9	1	2	35.5	33.5	45.3	51.8	41.5	0.0	60.0	195.0	320.0	143.8	0.0	0.0	0.0	0.0	0.0	20.0	6.0	8.0	8.0	2.0	44.0												
7	1	2	33.3	34.3	45.4	35.3	37.1	15.0	30.0	295.0	65.0	101.3	0.0	0.0	0.0	5.0	1.3	21.0	7.0	11.0	5.0	2.0	46.0												
7	1	1	35.5	34.1	46.0	39.4	38.7	70.0	65.0	60.0	165.0	90.0	0.0	0.0	60.0	0.0	15.0	26.0	8.0	13.0	9.0	2.0	58.0												
7	1	1	38.5	34.1	48.9	40.0	40.4	45.0	50.0	180.0	190.0	116.3	0.0	0.0	10.0	0.0	2.5	35.0	10.0	11.0	14.0	3.0	73.0												
7	1	1	45.3	43.0	42.0	32.0	40.6	120.0	60.0	0.0	60.0	60.0	60.0	60.0	60.0	0.0	45.0	35.0	9.0	11.0	8.0	2.0	65.0												
7	1	2	35.8	34.0	60.3	46.9	44.2	60.0	60.0	210.0	120.0	112.5	0.0	0.0	150.0	150.0	75.0	22.0	11.0	12.0	12.0	2.0	59.0	156.0	41.0	16.9	17.0	18.0	32.0	19.0	10.0	19.0	21.0	30.0	46.8
7	3	1	31.3	32.5	34.9	40.5	34.8	0.0	30.0	105.0	90.0	56.3	0.0	0.0	0.0	60.0	15.0	29.0	9.0	13.0	13.0	4.0	68.0	154.0	57.0	24.0	18.0	18.0	26.0	18.0	4.4	26.0	24.2	38.0	27.6
9	3	2	34.5	31.5	38.8	38.0	35.7	60.0	0.0	90.0	120.0	67.5	0.0	0.0	0.0	0.0	0.0	21.0	6.0	13.0	13.0	6.0	59.0												
9	3	2	34.5	33.7	42.5	36.9	36.9	35.0	0.0	0.0	10.0	11.3	0.0	0.0	60.0	70.0	32.5	33.0	11.0	15.0	11.0	5.0	75.0												
9	3	2	38.1	34.7	44.2	45.4	40.6	35.0	80.0	230.0	65.0	102.5	0.0	0.0	0.0	120.0	30.0	21.0	11.0	10.0	11.0	6.0	59.0												
7	1	2	34.9	35.2	33.2	36.3	34.9	30.0	25.0	0.0	30.0	21.3	0.0	0.0	0.0	0.0	0.0	27.0	6.0	13.0	7.0	4.0	57.0	156.0	71.0	29.2	22.0	19.0	24.0	14.0	4.0	25.0	24.2	35.0	26.8
8	1	2	36.2	33.7	49.2	36.7	38.9	30.0	40.0	360.0	100.0	132.5	0.0	0.0	0.0	0.0	0.0	27.0	7.0	11.0	13.0	2.0	60.0	163.0	66.0	24.8	23.0	22.0	29.0	18.0	3.6	22.0	19.2	30.0	26.8
7	3	2	41.9	36.8	49.7	34.1	40.6	210.0	120.0	205.0	10.0	136.3	0.0	0.0	0.0	0.0	0.0	36.0	12.0	11.0	15.0	8.0	82.0	160.0	49.0	19.1	17.0	16.0	27.0	15.0	3.5	12.0	14.2	21.0	26.8
7	3	2	38.4	35.9	40.3	37.0	37.9	100.0	45.0	170.0	115.0	107.5	0.0	15.0	0.0	0.0	3.8	36.0	13.0	11.0	15.0	2.0	77.0	149.0	57.0	25.7	17.0	17.0	30.0	9.0	3.5	20.0	23.0	31.0	26.8
8	1	2	33.9	34.1	39.2	33.2	35.1	30.0	0.0	40.0	60.0	32.5	0.0	0.0	35.0	0.0	8.8	29.0	12.0	14.0	12.0	5.0	72.0	160.0	45.0	17.6	21.0	16.0	17.0	16.0	8.2	11.0	11.0	19.0	40.5
9	1	2	35.8	32.3	37.5	33.6	34.8	0.0	90.0	135.0	40.0	66.3	0.0	0.0	0.0	0.0	0.0	34.0	4.0	13.0	11.0	3.0	65.0												
9	3	2	38.5	33.6	40.9	38.1	37.8	120.0	30.0	220.0	165.0	133.8	0.0	0.0	0.0	0.0	0.0	27.0	4.0	10.0	6.0	2.0	49.0												
9	3	1	31.8	31.7	32.7	31.2	31.8	0.0	0.0	10.0	25.0	8.8	0.0	0.0	0.0	0.0	0.0	21.0	5.0	7.0	12.0	3.0	48.0												
9	1	2	33.8	32.0	35.5	34.0	33.8	0.0	80.0	90.0	0.0	42.5	0.0	0.0	0.0	0.0	0.0	26.0	8.0	13.0	11.0	4.0	62.0	162.0	36.0	24.0	24.0	25.0	31.0	17.0	5.5	19.0	18.2	28.0	31.0
7	3	1	32.5	34.5	38.3	42.4	36.9	30.0	75.0	60.0	30.0	48.8	0.0	0.0	30.0	75.0	26.3	30.0	9.0	12.0	12.0	3.0	66.0	148.5	44.0	19.8	17.0	13.0	29.0	19.0	5.1	19.0	16.2	27.0	29.5
8	1	1	39.8	33.0	36.8	32.6	35.5	30.0	30.0	30.0	30.0	30.0	45.0	0.0	45.0	0.0	22.5	26.0	5.0	12.0	11.0	3.0	57.0												
7	1	1	44.2	35.3	43.1	54.5	44.3	100.0	90.0	300.0	510.0	250.0	120.0	0.0	45.0	0.0	41.3	33.0	14.0	14.0	12.0	3.0	76.0												
7	2	1	34.6	32.0	35.5	36.8	34.7	60.0	30.0	0.0	150.0	60.0	0.0	0.0	0.0	0.0	0.0	28.0	9.0	11.0	9.0	3.0	60.0												
7	1	1	36.4	39.4	52.1	57.2	46.3	110.0	165.0	30.0	10.0	78.8	0.0	0.0	120.0	180.0	75.0	32.0	14.0	14.0	12.0	2.0	74.0												
9	1	1	43.1	45.1	57.4	48.5	48.5	125.0	65.0	255.0	150.0	148.8	30.0	60.0	120.0	120.0	82.5	32.0	14.0	14.0	10.0	3.0	73.0												
8	1	2	34.4	33.2	38.0	40.8	36.6	0.0	40.0	35.0	140.0	53.8	0.0	0.0	0.0	0.0	0.0	17.0	10.0	12.0	12.0	5.0	56.0	158.5	46.0	18.4	25.0	23.0	28.0	14.0	5.2	14.0	11.4	20.0	30.2

7	1	1	35.3	44.1	54.9	47.7	45.5	50.0	60.0	300.0	140.0	137.5	0.0	65.0	80.0	120.0	66.3	33.0	7.0	11.0	11.0	5.0	67.0									
8	1	2	41.3	35.8	43.1	43.7	41.0	30.0	85.0	30.0	220.0	91.3	0.0	0.0	150.0	0.0	37.5	35.0	11.0	16.0	10.0	7.0	79.0									
8	1	1	46.6	40.1	46.8	57.8	47.8	330.0	140.0	60.0	0.0	132.5	0.0	0.0	60.0	180.0	60.0	25.0	10.0	11.0	13.0	2.0	61.0									
8	1	1	34.8	36.1	30.3	36.6	34.4	30.0	60.0	0.0	50.0	35.0	0.0	0.0	0.0	0.0	0.0	26.0	9.0	12.0	9.0	2.0	58.0									
7	1	1	37.7	39.2	38.3	38.8	38.5	145.0	180.0	90.0	120.0	133.8	0.0	0.0	0.0	0.0	0.0	33.0	12.0	11.0	12.0	3.0	71.0									
7	1	2	34.1	31.8	51.9	46.7	41.1	30.0	0.0	300.0	335.0	166.3	0.0	0.0	30.0	0.0	7.5	33.0	11.0	14.0	11.0	5.0	74.0									
7	1	1	35.4	47.5	55.7	61.0	49.9	105.0	60.0	0.0	60.0	56.3	0.0	120.0	120.0	180.0	105.0	34.0	15.0	12.0	11.0	3.0	75.0									
7	3	2	32.6	34.0	36.2	33.7	34.1	0.0	20.0	30.0	15.0	16.3	0.0	0.0	15.0	30.0	11.3	32.0	13.0	14.0	9.0	4.0	72.0									
9	2	1	38.8	33.0	45.8	47.8	41.3	20.0	20.0	320.0	0.0	90.0	40.0	2.0	0.0	120.0	40.5	34.0	14.0	12.0	12.0	3.0	75.0									
9	3	1	38.3	37.4	51.5	36.8	41.0	0.0	90.0	360.0	150.0	150.0	60.0	30.0	60.0	0.0	37.5	24.0	9.0	12.0	9.0	7.0	61.0	183.0	68.0	20.3	35.0	33.0	18.0	25.0	9.2	12.0	19.8	25.0	43.9
9	3	2	31.3	33.5	36.1	33.5	33.6	0.0	30.0	110.0	0.0	35.0	0.0	0.0	0.0	0.0	0.0	14.0	9.0	11.0	11.0	7.0	52.0												
9	3	1	41.2	40.8	38.0	38.5	39.6	240.0	170.0	60.0	120.0	147.5	0.0	0.0	60.0	60.0	30.0	30.0	14.0	13.0	7.0	4.0	68.0	166.0	75.0	27.2	19.0	23.0	15.0	16.0	3.4	19.0	24.0	33.0	26.8
8	3	1	36.8	33.8	37.8	34.5	35.7	45.0	30.0	0.0	0.0	18.8	0.0	0.0	30.0	0.0	7.5	24.0	10.0	7.0	9.0	2.0	52.0												
9	1	2	41.2	33.7	34.3	34.5	35.9	20.0	0.0	40.0	60.0	30.0	0.0	60.0	0.0	0.0	15.0	24.0	6.0	12.0	12.0	4.0	58.0	162.5	58.0	22.1	28.0	23.0	33.0	15.0	5.6	16.0	18.8	27.0	31.8
9	1	2	32.2	34.6	41.1	36.7	36.1	0.0	30.0	15.0	120.0	41.3	45.0	0.0	105.0	0.0	37.5	27.0	12.0	12.0	10.0	2.0	63.0												
8	2	2	31.5	31.8	31.0	30.5	31.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.0	13.0	11.0	8.0	4.0	68.0	163.0	79.0	29.7	14.0	22.0	22.0	15.0	3.5	26.0	29.8	39.0	26.8
8	1	2	32.5	37.1	37.0	34.6	35.3	60.0	0.0	0.0	70.0	32.5	0.0	0.0	0.0	0.0	0.0	17.0	5.0	14.0	13.0	3.0	52.0	146.0	36.0	16.9	18.0	14.0	17.0	14.0	7.2	17.0	18.8	27.0	37.1
9	2	1	40.0	40.5	49.7	42.5	43.2	150.0	180.0	180.0	230.0	185.0	0.0	0.0	80.0	40.0	30.0	32.0	11.0	12.0	11.0	3.0	69.0												
9	3	2	33.9	32.5	32.8	33.3	33.1	0.0	5.0	0.0	30.0	8.8	0.0	5.0	0.0	0.0	1.3	24.0	8.0	9.0	9.0	4.0	54.0												
9	1	2	46.3	41.9	46.4	39.8	43.6	10.0	10.0	290.0	70.0	95.0	60.0	90.0	0.0	60.0	52.5	26.0	4.0	11.0	10.0	2.0	53.0	160.0	51.0	19.9	24.0	24.0	36.0	16.0	4.2	21.0	15.6	27.0	27.6
9	1	2	41.0	33.2	43.0	37.3	38.6	30.0	120.0	150.0	90.0	97.5	0.0	60.0	0.0	0.0	15.0	34.0	7.0	6.0	13.0	4.0	64.0												
8	1	2	46.3	38.1	51.2	65.0	50.2	20.0	120.0	255.0	590.0	246.3	0.0	60.0	0.0	0.0	15.0	30.0	11.0	13.0	10.0	2.0	66.0	155.0	55.0	22.9	24.0	24.0	29.0	17.0	4.8	19.0	20.8	30.0	28.3
8	1	1	32.9	33.6	50.8	35.0	38.1	20.0	50.0	20.0	65.0	38.8	0.0	0.0	120.0	0.0	30.0	33.0	8.0	12.0	11.0	5.0	69.0	152.5	36.0	15.6	14.0	18.0	24.0	20.0	7.8	10.0	13.0	18.0	39.2
7	1	2	35.0	31.5	34.3	33.1	33.5	60.0	0.0	30.0	45.0	33.8	0.0	0.0	30.0	0.0	7.5	25.0	11.0	11.0	12.0	3.0	62.0												
7	1	1	37.0	40.0	36.1	40.5	38.4	75.0	90.0	0.0	240.0	101.3	15.0	60.0	30.0	0.0	26.3	27.0	13.0	13.0	9.0	2.0	64.0												
9	3	2	33.3	32.5	33.6	31.7	32.7	35.0	10.0	45.0	30.0	30.0	0.0	0.0	0.0	0.0	0.0	33.0	13.0	11.0	13.0	2.0	72.0												
8	2	1	35.5	36.8	32.9	36.5	35.4	50.0	100.0	45.0	120.0	78.8	0.0	0.0	0.0	0.0	0.0	36.0	14.0	14.0	7.0	2.0	73.0	160.0	50.0	19.5	26.0	24.0	21.0	24.0	8.8	6.0	9.0	12.0	42.4
7	1	1	45.0	46.1	41.5	50.5	45.8	120.0	170.0	180.0	120.0	147.5	60.0	60.0	0.0	120.0	60.0	35.0	15.0	13.0	6.0	2.0	71.0												
7	2	1	36.1	33.5	37.0	36.0	35.6	120.0	60.0	15.0	120.0	78.8	0.0	0.0	0.0	0.0	0.0	27.0	14.0	13.0	11.0	8.0	73.0	154.5	47.0	19.8	28.0	25.0	37.0	19.0	5.4	11.0	10.0	16.0	31.0
8	1	1	37.2	33.0	33.5	34.5	34.6	95.0	20.0	0.0	0.0	28.8	0.0	0.0	0.0	15.0	3.8	21.0	8.0	15.0	12.0	3.0	59.0												
7	1	2	34.2	34.7	43.0	37.8	37.4	45.0	90.0	180.0	150.0	116.3	0.0	0.0	0.0	0.0	0.0	28.0	13.0	14.0	4.0	2.0	61.0												
8	1	2	35.3	38.3	44.0	34.8	38.1	60.0	135.0	140.0	30.0	91.3	0.0	0.0	60.0	80.0	35.0	28.0	10.0	14.0	11.0	4.0	67.0	154.0	43.0	18.1			24.0	18.0	5.1	12.0	15.6	22.0	29.5
9	1	2	37.3	33.1	48.9	41.7	40.2	0.0	50.0	180.0	15.0	61.3	0.0	10.0	0.0	60.0	17.5	36.0	13.0	13.0	13.0	5.0	80.0												
9	1	2	32.0	30.4	44.6	35.0	35.5	0.0	0.0	270.0	90.0	90.0	0.0	0.0	0.0	0.0	0.0	25.0	14.0	12.0	14.0	6.0	71.0												
8	2	2	38.9	38.2	49.8	38.3	41.3	30.0	85.0	270.0	60.0	111.3	30.0	30.0	0.0	0.0	15.0	28.0	10.0	11.0	11.0	4.0	64.0	163.0	48.0	18.1	28.0	25.0	40.0	17.0	8.4	11.0	8.8	17.0	41.1
7	1	2	33.3	33.2	39.1	40.0	36.4	45.0	45.0	90.0	180.0	90.0	0.0	0.0	0.0	0.0	0.0	35.0	13.0	10.0	4.0	2.0	64.0												
9	1	2	32.8	33.0	35.4	30.3	32.9	0.0	30.0	15.0	30.0	18.8	0.0	0.0	10.0	0.0	2.5	26.0	8.0	16.0	15.0	4.0	69.0												
7	1	2	33.3	30.5	33.3	44.8	35.5	0.0	0.0	30.0	0.0	7.5	0.0	0.0	30.0	90.0	30.0	16.0	9.0	11.0	9.0	4.0	49.0												
7	1	1	39.7	32.5	38.8	46.7	39.4	100.0	20.0	180.0	220.0	130.0	0.0	0.0	0.0	70.0	17.5	33.0	14.0	10.0	9.0	3.0	69.0	149.5	40.0	18.0	20.0	22.0	32.0	25.0	9.0	10.0	11.4	17.0	43.3
9	1	2	35.0	48.5	33.8	37.5	38.7	0.0	0.0	30.0	60.0	22.5	120.0	0.0	0.0	0.0	30.0	32.0	10.0	11.0	11.0	3.0	67.0												
7	3	2	33.7	32.6	33.9	34.1	33.6	10.0	15.0	45.0	60.0	32.5	0.0	0.0	0.0	0.0	0.0	28.0	11.0	10.0	10.0	5.0	64.0												
9	3	2	32.1	31.9	35.8	32.0	33.0	0.0	0.0	100.0	5.0	26.3	0.0	0.0	0.0	0.0	0.0	26.0	8.0	10.0	11.0	3.0	58.0												
8	1	1	39.8	49.7	49.9	40.2	44.9	30.0	40.0	80.0	120.0	67.5	60.0	120.0	150.0	60.0	97.5	24.0	10.0	13.0	9.0	3.0	59.0	150.0	50.0	22.2	23.0	19.0	22.0	26.0	5.5	18.0	21.0	30.0	31.0
7	1	1	31.4	32.1	57.7	45.6	41.7	15.0	10.0	140.0	115.0	70.0	0.0	20.0	150.0	0.0	42.5	36.0	10.0	12.0	10.0	2.0	70.0												
7	1	2	38.9	31.6	40.3	42.5	38.4	145.0	0.0	155.0	255.0	138.8	0.0	0.0	0.0	0.0	0.0	12.0	9.0	5.0	4.0	2.0	32.0												
7	2	2	32.8	36.3	48.1	44.1	40.3	0.0	100.0	180.0	210.0	122.5	0.0	0.0	60.0	40.0	25.0	30.0	12.0	13.0	15.0	7.0	77.0	149.0	47.0	21.2	27.0	28.0	42.0	18.0	9.8	27.0	24.0	36.0	45.8
8	1	2	35.3	33.5	41.4	39.3	37.4	60.0	0.0	30.0	150.0	60.0	0.0	0.0	50.0	0.0	12.5	34.0	15.0	15.0	12.0	3.0	79.0	163.0	54.0	20.3	22.0	19.0	23.0	19.0	7.2	16.0	13.2	23.0	37.1
9	3	2	35.4	33.8	38.1	29.2	34.1	35.0	30.0	75.0	0.0	35.0	15.0	0.0	0.0	0.0	3.8	22.0	4.0	7.0	9.0	2.0	44.0	151.5	43.0	18.9	17.0	20.0	22.0	25.0	4.5	18.0	23.4	30.0	27.6
7	2	2	36.8	31.5	43.7	36.7	37.2	55.0	0.0	150.0	125.0	82.5	30.0	0.0	55.0	0.0	21.3	20.0	7.0	8.0	4.0	2.0	41.0	155.0	40.1	16.7	22.0	21.0	23.0	22.0	7.1	22.0	19.0	30.0	36.4
8	1	2	31.9	38.1	29.8	44.8	36.1	0.0	60.0	0.0	0.0	15.0	0.0	0.0	0.0	90.0	22.5	33.0	14.0	14.0	14.0	2.0	77.0	158.0	49.0	19.6	29.0	25.0	39.0	19.0	5.5	16.0	22.2	28.0	31.0
7	1	2	31.8	32.4	33.5	32.9	32.7	0.0	0.0	60.0	30.0	22.5	0.0	0.0	0.0	0.0	0.0	34.0	16.0	13.0	16.0	5.0	84.0												
9	1	2	35.5	33.3	39.0	33.8	35.4	20.0	20.0	80.0	60.0	45.0	0.0	25.0	0.0	0.0	6.3	26.0	7.0	11.0	12.0	4.0	60.0												
8	1	2	49.6	50.0	40.5	59.0	49.8	0.0	0.0	90.0	0.0	22.5	120.0	120.0	70.0	360.0	167.5	36.0	11.0	14.0	16.0	6.0	83.0	159.5	47.0	18.6	22.0	19.0	32.0	23.0	9.6	12.0	9.6	18.0	45.2
9	1	2	43.1	33.0	56.2	42.0	43.6	0.0	30.0	150.0	210.0	97.5	0.0	60.0	120.0	0.0	45.0	30.0	4.0	13.0	13.0	3.0	63.0												
8	1	2	34.6	35.6	56.7	39.7	41.7	30.0	0.0	140.0	120.0	72.5	15.0	0.0	240.0	0.0	63.8	32.0	13.0	13.0	16.0	7.0	81.0	168.0	67.0	23.7	20.0	16.0	21.0	15.0	3.2	29.0	25.5	38.0	26.8
9	2	2	33.5	35.6	37.2	31.5	34.4	5.0	75.0	30.0	0.0	27.5	0.0	0.0	0.0	0.0	0.0	23.0	4.0	8.0	6.0	2.0	43.0	171.0	60.0	20.5	28.0	27.0	24.0	22.0	4.3	14.0	9.0	19.0	26.8
9	1	1	36.8	38.9	43.4	44.2	40.8	120.0	145.0	220.0	250.0	183.8	0.0	0.0	0.0	0.0	0.0	27.0	12.0	10.0	9.0	2.0	60.0												
9	3	2	35.1	32.9	36.3	43.3	36.9	0.0	0.0	45.0	0.0	11.3	0.0	0.0	0.0	0.0	0.0	20.0	9.0	11.0	10.0	3.0	53.0												
7	1	2	37.8	35.7	39.0	34.5	36.7	140.0	95.0	60.0	50.0	86.3	0.0	0.0	40.0	0.0	10.0	26.0	7.0	9.0	12.0	2.0	58.0												
7	2	1	37.8	33.3	29.8	39.3	35.0	90.0	0.0	0.0	0.0	22.5	0.0	0.0	0.0	0.0	0.0	17.0	10.0	11.0	9.0	5.0	52.0												
7	2	1	32.4	31.9	39.3	31.5	33.8	15.0	30.0	80.0	0.0	31.3	0.0	0.0	60.0	0.0	15.0	24.0	11.0	9.0	8.0	4.0	56.0												
7	2	1	35.9	37.5	41.3	46.5	40.3	40.0	75.0	160.0	60.0	83.8	0.0	0.0	0.0	0.0	0.0	29.0	11.0	14.0	14.0	4.0	72.0	142.5	30.0	14.9	16.0	15.0	28.0	19.0	7.8	7.0	7.0	11.0	39.2
7	1	1	42.7	35.6	62.0	41.4	45.4	50.0	85.0	60.0	50.0	61.3	60.0	0.0	180.0	55.0	73.8	30.0	11.0	12.0	9.0	2.0	64.0												
7	2	1	33.7	32.6	37.4	31.5	33.8	60.0	45.0	75.0	30.0	52.5	0.0	0.0	0.0	0.0	0.0	26.0	9.0	9.0	13.0	3.0	60.0	148.0	36.0	16.4	22.0	21.0	28.0	23.0	8.0	12.0	8.6	16.0	39.9

7	1	1	33.4	35.3	36.8	36.8	35.6	15.0	50.0	30.0	60.0	38.8	0.0	20.0	30.0	20.0	17.5	31.0	13.0	12.0	16.0	6.0	78.0									
7	1	1	41.5	55.3	50.0	49.8	49.1	35.0	60.0	420.0	450.0	241.3	60.0	150.0	0.0	0.0	52.5	33.0	13.0	12.0	10.0	2.0	70.0									
9	1	2	32.0	28.9	42.4	33.0	34.1	0.0	0.0	250.0	30.0	70.0	0.0	0.0	0.0	0.0	0.0	13.0	6.0	12.0	9.0	2.0	42.0	160.0	60.0	23.4	20.0	20.0	22.0	18.0	4.0	31.0	26.0	40.0	26.8
9	2	2	40.2	35.6	48.5	43.5	41.9	205.0	45.0	150.0	300.0	175.0	0.0	0.0	150.0	0.0	37.5	22.0	14.0	10.0	10.0	2.0	58.0												
7	3	2	36.9	32.5	33.8	32.3	33.8	90.0	15.0	55.0	35.0	48.8	0.0	0.0	0.0	0.0	0.0	34.0	9.0	10.0	11.0	2.0	66.0	142.0	34.0	16.9	13.0	11.0	29.0	17.0	3.5	14.0	13.0	22.0	26.8
8	1	2	34.8	33.9	54.3	33.3	39.1	0.0	30.0	240.0	20.0	72.5	0.0	0.0	90.0	0.0	22.5	24.0	10.0	16.0	10.0	2.0	62.0												
7	1	2	42.5	36.9	47.8	39.7	41.7	120.0	60.0	240.0	180.0	150.0	60.0	0.0	60.0	0.0	30.0	30.0	10.0	15.0	11.0	6.0	72.0	143.5		16.6	15.0	15.0	24.0	19.0	10.0	17.0	20.0	28.0	46.8
7	2	2	34.8	35.4	48.8	40.0	39.7	20.0	30.0	60.0	120.0	57.5	10.0	10.0	90.0	30.0	35.0	29.0	7.0	14.0	13.0	2.0	65.0	163.0	64.0	24.1	20.0	20.0	32.0	21.0	5.0	30.0	25.4	39.0	29.5
9	1	2	38.9	43.5	38.8	36.3	39.4	0.0	0.0	180.0	90.0	67.5	140.0	25.0	0.0	0.0	41.3	27.0	8.0	11.0	7.0	3.0	56.0	156.0	53.0	21.8	20.0	16.0	18.0	18.0	4.0	31.0	18.2	35.0	26.8
7	1	2	36.8	36.9	36.6	35.3	36.4	90.0	30.0	0.0	60.0	45.0	0.0	0.0	0.0	0.0	0.0	29.0	11.0	11.0	10.0	4.0	65.0												
7	1	2	39.6	33.5	38.8	38.3	37.6	150.0	30.0	150.0	150.0	120.0	15.0	0.0	0.0	0.0	3.8	26.0	11.0	12.0	12.0	2.0	63.0												
8	1	1	50.6	37.9	50.2	34.5	43.3	20.0	105.0	180.0	90.0	98.8	120.0	0.0	60.0	0.0	45.0	35.0	13.0	12.0	8.0	2.0	70.0												
7	1	1	34.7	35.1	48.5	35.5	38.4	70.0	80.0	0.0	60.0	52.5	0.0	0.0	150.0	0.0	37.5	27.0	6.0	12.0	14.0	2.0	61.0	144.0	45.0	21.7	16.0	13.0	20.0	28.0	4.4	17.0	16.4	25.0	27.6
9	1	2	35.6	39.9	45.4	34.7	38.9	0.0	100.0	100.0	30.0	57.5	15.0	30.0	70.0	50.0	41.3	22.0	5.0	13.0	10.0	5.0	55.0												
9	1	2	34.8	38.3	50.4	41.8	41.3	80.0	150.0	360.0	180.0	192.5	0.0	0.0	0.0	45.0	11.3	19.0	9.0	13.0	6.0	2.0	49.0	156.0	47.0	19.3	22.0	21.0	20.0	20.0	6.6	27.0	24.4	36.0	35.0
9	3	2	36.1	33.2	36.8	36.0	35.5	60.0	0.0	60.0	60.0	45.0	0.0	0.0	0.0	0.0	0.0	26.0	10.0	9.0	15.0	3.0	63.0												
7	1	2	31.5	34.3	44.0	41.1	37.7	0.0	0.0	60.0	150.0	52.5	0.0	30.0	120.0	0.0	37.5	31.0	10.0	15.0	10.0	5.0	71.0												
8	3	1	40.9	35.6	58.4	37.6	43.4	100.0	135.0	105.0	195.0	133.8	60.0	0.0	150.0	0.0	52.5	34.0	14.0	12.0	15.0	2.0	77.0												
7	3	1	33.6	35.6	41.6	32.6	35.9	60.0	0.0	255.0	60.0	93.8	0.0	45.0	0.0	0.0	11.3	27.0	10.0	13.0	14.0	3.0	67.0	158.0	37.0	14.8	16.0	16.0	28.0	15.0	6.7	9.0	8.2	16.0	35.0
9	3	2	33.3	34.0	37.7	35.0	35.0	25.0	0.0	95.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	19.0	7.0	13.0	10.0	5.0	54.0												
7	2	2	34.7	37.3	37.7	36.8	36.6	70.0	120.0	140.0	60.0	97.5	0.0	0.0	0.0	0.0	0.0	21.0	9.0	10.0	7.0	2.0	49.0	162.0	42.0	16.0	20.0	18.0	24.0	19.0	7.8	9.0	10.8	17.0	39.2
7	3	2	32.6	31.6	37.3	31.2	33.2	30.0	0.0	150.0	35.0	53.8	0.0	0.0	0.0	0.0	0.0	35.0	14.0	7.0	6.0	2.0	64.0												
7	1	1	37.5	38.2	42.0	29.3	38.7	105.0	60.0	255.0	0.0	105.0	0.0	60.0	0.0	0.0	15.0	29.0	13.0	14.0	10.0	2.0	68.0	141.5	35.0	17.4	15.0	14.0	31.0	19.0	7.6	10.0	12.4	18.0	38.5
9	1	1	32.5	31.9	35.3	31.4	32.8	0.0	0.0	70.0	15.0	21.3	0.0	0.0	0.0	0.0	0.0	21.0	9.0	13.0	13.0	2.0	58.0												
7	3	2	33.7	36.8	40.9	44.8	39.0	35.0	100.0	215.0	125.0	118.8	0.0	0.0	0.0	45.0	11.3	34.0	10.0	11.0	9.0	3.0	67.0	143.5	33.0	16.1	13.0	12.0	27.0	16.0	3.5	14.0	9.0	19.0	26.8
9	1	1	44.0	45.8	52.5	40.5	45.7	60.0	170.0	380.0	90.0	175.0	120.0	90.0	0.0	0.0	52.5	31.0	9.0	10.0	11.0	2.0	63.0												
7	1	1	33.4	38.5	34.5	38.0	36.1	40.0	60.0	105.0	180.0	96.3	0.0	60.0	30.0	0.0	22.5	29.0	11.0	13.0	12.0	3.0	68.0												
8	3	2	33.3	32.8	35.8	30.0	32.9	30.0	30.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	32.0	6.0	11.0	16.0	6.0	71.0												
8	2	2	44.7	59.8	38.7	51.1	48.6	40.0	220.0	190.0	300.0	187.5	60.0	120.0	0.0	0.0	45.0	30.0	8.0	15.0	10.0	2.0	65.0	161.0	56.0	21.6	24.0	24.0	41.0	21.0	4.0	26.0	26.8	37.0	26.8
9	3	2	32.6	31.8	34.2	35.0	33.4	30.0	0.0	5.0	60.0	23.8	0.0	0.0	0.0	0.0	0.0	21.0	8.0	12.0	11.0	5.0	57.0												
7	2	2	32.3	35.3	59.8	37.3	41.2	0.0	0.0	450.0	0.0	112.5	0.0	0.0	30.0	0.0	7.5	22.0	9.0	8.0	8.0	2.0	49.0	158.5	45.0	18.4	15.0	11.0	34.0	18.0	5.2	15.0	11.0	21.0	30.2
9	1	2	33.4	38.6	37.0	34.8	36.0	30.0	55.0	90.0	50.0	56.3	0.0	0.0	0.0	0.0	0.0	19.0	6.0	9.0	12.0	3.0	49.0												
9	1	1	42.7	39.9	60.6	47.3	47.6	120.0	180.0	115.0	100.0	128.8	60.0	0.0	240.0	120.0	105.0	28.0	9.0	10.0	9.0	2.0	58.0	159.0	2.0	16.6	17.0	18.0	21.0	34.0	9.1	13.0	12.2	20.0	46.8
8	1	1	34.0	35.0	41.9	46.5	39.3	0.0	60.0	0.0	120.0	45.0	0.0	0.0	70.0	60.0	32.5	28.0	9.0	6.0	13.0	3.0	59.0												
7	1	1	35.9	38.1	60.8	41.1	44.0	90.0	120.0	60.0	240.0	127.5	0.0	0.0	330.0	0.0	82.5	32.0	13.0	11.0	11.0	5.0	72.0												
8	1	1	38.6	45.7	46.5	39.5	42.6	110.0	60.0	210.0	180.0	140.0	0.0	120.0	0.0	0.0	30.0	36.0	12.0	15.0	13.0	2.0	78.0	159.0	50.0	19.8	18.0	16.0	7.0	21.0	6.0	14.0	16.5	23.0	32.9
7	1	2	32.3	34.7	54.3	38.8	40.0	0.0	60.0	330.0	150.0	135.0	0.0	0.0	60.0	0.0	15.0	23.0	5.0	11.0	10.0	2.0	51.0												
8	1	2	33.7	32.2	33.3	32.6	32.9	0.0	0.0	0.0	20.0	5.0	0.0	0.0	0.0	0.0	0.0	33.0	10.0	14.0	10.0	4.0	71.0	164.0	49.0	18.2	17.0	16.0	26.0	17.0	5.1	15.0	15.4	23.0	29.5
9	1	2	32.9	35.2	46.3	32.0	36.6	30.0	70.0	90.0	30.0	55.0	0.0	0.0	60.0	0.0	15.0	14.0	5.0	12.0	9.0	2.0	42.0												
9	1	2	33.3	34.3	34.0	35.0	34.1	60.0	0.0	60.0	60.0	45.0	0.0	0.0	0.0	0.0	0.0	13.0	10.0	15.0	11.0	2.0	51.0	165.0	57.0	20.9	19.0	19.0	24.0	17.0	4.5	20.0	17.6	28.0	27.6
8	1	2	37.1	33.6	40.9	34.3	36.5	20.0	100.0	180.0	40.0	85.0	0.0	0.0	0.0	0.0	0.0	31.0	7.0	16.0	11.0	2.0	67.0	158.0	41.0	16.4	15.0	16.0	23.0	8.0	6.0	5.0	5.6	12.0	31.8
7	1	2	38.9	36.6	45.1	36.1	39.2	145.0	90.0	270.0	105.0	152.5	0.0	0.0	0.0	0.0	0.0	36.0	13.0	11.0	15.0	2.0	77.0	157.0	37.0	15.0	13.0	13.0	27.0	14.0	5.2	9.0	10.0	17.0	30.2
9	3	2	34.1	33.8	32.4	31.8	33.0	15.0	20.0	25.0	25.0	21.3	0.0	0.0	0.0	0.0	0.0	24.0	9.0	8.0	9.0	2.0	52.0												
7	3	1	32.7	33.5	35.8	37.4	34.8	30.0	60.0	120.0	195.0	101.3	0.0	0.0	0.0	0.0	0.0	25.0	11.0	12.0	9.0	4.0	61.0	143.0	26.0	12.7	15.0	14.0	19.0	16.0	6.6	7.0	6.8	11.0	35.7
7	3	2	34.3	34.0	34.1	31.0	33.4	65.0	60.0	40.0	15.0	45.0	0.0	0.0	0.0	0.0	0.0	33.0	10.0	12.0	16.0	2.0	73.0												
7	3	2	31.0	31.5	31.9	33.3	31.9	0.0	0.0	0.0	60.0	15.0	0.0	0.0	0.0	0.0	0.0	21.0	7.0	12.0	9.0	4.0	53.0	151.5	35.0	15.4	20.0	15.0	32.0	16.0	6.6	15.0	18.0	23.0	35.0
9	1	2	37.8	32.7	46.9	32.7	37.5	10.0	120.0	120.0	0.0	62.5	0.0	0.0	120.0	0.0	30.0	22.0	10.0	10.0	10.0	3.0	55.0	166.5	63.0	22.9	21.0	19.0	29.0	7.0	6.4	19.0	22.4	30.0	34.3
9	1	2	39.8	35.1	50.4	32.1	39.4	30.0	10.0	370.0	0.0	102.5	0.0	30.0	30.0	0.0	15.0	31.0	10.0	15.0	15.0	3.0	74.0	162.5	66.0	25.2	26.0	27.0	33.0	14.0	7.1	23.0	11.6	26.0	38.4
9	1	2	38.9	43.5	38.8	36.3	39.4	0.0	0.0	10.0	195.0	51.3	0.0	0.0	15.0	0.0	3.8	24.0	10.0	12.0	9.0	2.0	57.0	163.0	46.0	17.3	22.0	20.0	36.0	16.0	5.8	14.0	16.4	23.0	31.8
8	1	2	35.5	33.6	31.8	35.3	34.0	10.0	0.0	10.0	15.0	8.8	0.0	0.0	10.0	0.0	2.5	31.0	13.0	11.0	8.0	2.0	65.0	158.0	51.0	20.4	23.0	24.0	35.0	20.0	5.3	15.0	15.0	23.0	30.2
7	1	2	31.4	32.7	32.4	39.8	34.1	10.0	15.0	60.0	0.0	21.3	0.0	0.0	0.0	120.0	30.0	33.0	12.0	12.0	16.0	8.0	81.0												
8	1	2	40.2	37.8	0.0	0.0	19.5	140.0	90.0	0.0	0.0	57.5	0.0	60.0	0.0	0.0	15.0	31.0	11.0	12.0	12.0	3.0	69.0												
8	1	2	31.9	32.2	31.7	30.3	31.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	13.0	13.0	10.0	2.0	65.0	154.0	32.0	13.5	19.0	18.0	20.0	18.0	5.0	12.0	11.0	19.0	29.5
9	1	2	37.2	39.4	39.6	32.8	37.2	60.0	10.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0	27.0	11.0	13.0	13.0	2.0	66.0	158.0	58.0	23.2	21.0	20.0	22.0	19.0	6.4	22.0	18.4	30.0	34.3
9	3	2	36.5	34.1	35.8	32.5	34.7	80.0	25.0	80.0	0.0	46.3	0.0	0.0	0.0	0.0	0.0	33.0	13.0	11.0	10.0	2.0	69.0												
8	3	2	33.3	34.0	37.0	33.3	34.4	35.0	30.0	50.0	60.0	43.8	0.0	0.0	0.0	0.0	0.0	22.0	10.0	10.0	8.0	3.0	53.0												
8	1	2	41.8	44.9	37.1	34.9	39.7	160.0	65.0	20.0	60.0	76.3	0.0	45.0	30.0	40.0	28.8	29.0	15.0	7.0	12.0	2.0	65.0	154.5	45.0	19.0	18.0	20.0	32.0	17.0	6.7	17.0	15.0	25.0	35.0
9	1	1	32.4	36.0	34.3	33.8	34.1	0.0	100.0	60.0	60.0	55.0	0.0	0.0	0.0	0.0	0.0	23.0	8.0	9.0	4.0	2.0	46.0												
8	3	2	32.2	32.7	36.8	32.1	33.5	35.0	35.0	100.0	35.0	51.3	0.0	0.0	20.0	0.0	5.0	31.0	15.0	13.0	14.0	7.0	80.0												
9	1	2	40.8	36.3	54.9	41.5	43.3	0.0	30.0	0.0	90.0	30.0	60.0	75.0	165.0	60.0	90.0	20.0	6.0	8.0	6.0	2.0	42.0	150.0	50.0	22.2	22.0	23.0	27.0	11.0	5.4	27.0	17.8	33.0	31.0
9	3	2	31.8	34.1	30.8	32.4	32.3	0.0	60.0	0.0	40.0	25.0	0.0	0.0	0.0	0.0	0.0	29.0	8.0	12.0	11.0	3.0	63.0												
7	3	2	32.1	32.4	34.8	30.7	32.5	0.0	0.0	90.0	10.0	25.0	0.0	0.0	0.0	0.0	0.0	32.0	12.0	10.0	8.0	2.0	64.0												
9	1	1	32.6	32.6	38.6	32.3	34.0	0.0	10.0	120.0	0.0	32.5	0.0	0.0	0.0	0.0	0.0	9.0	8.0	10.0	7.0	4.0	38.0												
9	1	1	33.1	34.9	41.5	37.8	36.8	0.0	45.0	120.0	180.0	86.3	0.0	0.0	0.0	0.0	0.0	16.0	8.0	5.0	7.0	2.0	38.0												

7	2	1	37.4	31.4	69.8	37.3	44.0	140.0	0.0	120.0	120.0	95.0	0.0	0.0	290.0	0.0	72.5	29.0	11.0	14.0	11.0	3.0	68.0												
7	2	2	32.5	32.0	32.5	31.8	32.2	0.0	0.0	0.0	30.0	7.5	0.0	0.0	0.0	0.0	0.0	23.0	11.0	11.0	10.0	2.0	57.0	158.0	44.0	17.6	25.0	21.0	12.0	22.0	9.4	10.0	5.5	17.0	31.0
9	1	1	35.8	33.0	34.8	36.3	34.9	90.0	60.0	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	28.0	4.0	13.0	8.0	2.0	55.0												
9	1	1	33.3	39.9	44.3	41.3	39.7	30.0	190.0	300.0	90.0	152.5	0.0	0.0	0.0	90.0	22.5	30.0	18.0	11.0	14.0	5.0	78.0												
7	3	2	31.7	34.3	44.3	39.7	37.5	20.0	40.0	210.0	135.0	101.3	0.0	0.0	0.0	0.0	0.0	32.0	7.0	16.0	14.0	8.0	77.0	161.0	74.0	28.6	27.0	28.0	35.0	14.0	6.1	42.0	38.0	53.0	32.9
7	1	1	34.4	36.9	42.7	45.2	39.8	70.0	115.0	100.0	50.0	83.8	0.0	0.0	60.0	160.0	55.0	27.0	8.0	9.0	10.0	2.0	56.0												
8	1	1	32.8	33.1	29.3	27.4	30.6	0.0	30.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	26.0	7.0	14.0	13.0	3.0	63.0												
8	2	2	39.2	34.8	40.1	34.3	37.1	60.0	0.0	15.0	80.0	38.8	0.0	10.0	40.0	0.0	12.5	31.0	13.0	12.0	14.0	5.0	75.0	156.5	45.0	18.5	28.0	27.0	35.0	20.0	6.7	12.0	11.2	19.0	35.0
8	2	1	32.7	41.0	43.1	37.1	38.5	0.0	75.0	90.0	120.0	71.3	0.0	45.0	60.0	0.0	26.3	32.0	9.0	9.0	11.0	3.0	64.0												
7	3	2	38.1	35.1	39.3	36.8	37.3	50.0	30.0	30.0	120.0	57.5	60.0	0.0	0.0	0.0	15.0	32.0	4.0	9.0	16.0	2.0	63.0												
9	1	2	31.8	32.2	39.4	34.5	34.4	0.0	0.0	0.0	30.0	7.5	0.0	0.0	0.0	0.0	0.0	14.0	8.0	14.0	9.0	5.0	50.0	163.0	56.0	21.1	21.0	16.0	12.0	14.0	5.4	18.0	14.8	25.0	31.0
7	1	2	31.3	37.8	36.8	32.3	34.5	0.0	120.0	30.0	30.0	45.0	0.0	0.0	0.0	0.0	0.0	25.0	8.0	14.0	13.0	5.0	65.0	154.5	49.0	20.7	15.0	12.0	16.0	16.0	5.0	25.0	19.8	33.0	29.5
8	1	2	48.5	41.3	47.5	36.1	43.4	270.0	200.0	120.0	145.0	183.8	60.0	0.0	120.0	0.0	45.0	32.0	7.0	13.0	9.0	2.0	63.0	149.5	45.0	20.3	16.0	16.0	34.0	22.0	5.4	21.0	25.2	33.0	31.0
9	1	2	32.2	35.9	35.5	38.5	35.5	90.0	0.0	45.0	180.0	78.8	0.0	0.0	30.0	0.0	7.5	19.0	6.0	14.0	9.0	3.0	51.0												
9	3	2	37.4	39.8	45.8	36.8	39.9	0.0	70.0	180.0	30.0	70.0	0.0	0.0	0.0	0.0	0.0	25.0	9.0	13.0	10.0	4.0	61.0	162.0	57.0	21.7	29.0	27.0	8.0	19.0	4.9	29.0	27.1	39.0	28.3
7	2	2	32.5	32.4	38.6	34.8	34.6	10.0	15.0	60.0	120.0	51.3	0.0	0.0	0.0	0.0	0.0	35.0	12.0	12.0	14.0	6.0	79.0												
7	3	1	34.2	37.5	37.3	34.4	35.8	15.0	105.0	90.0	90.0	75.0	0.0	0.0	0.0	0.0	0.0	36.0	9.0	13.0	13.0	2.0	73.0	146.0	36.0	16.9	16.0	17.0	22.0	18.0	4.4	15.0	14.0	22.0	27.6
7	3	1	33.7	33.9	53.1	36.4	39.3	30.0	40.0	150.0	35.0	63.8	0.0	0.0	105.0	20.0	31.3	30.0	9.0	8.0	13.0	2.0	62.0	161.0	55.0	21.2	15.0	13.0	14.0	11.0	4.4	21.0	9.2	23.0	27.6
8	3	2	40.9	40.3	41.3	41.8	41.1	150.0	120.0	160.0	170.0	150.0	0.0	0.0	0.0	0.0	0.0	27.0	10.0	11.0	11.0	6.0	65.0												
8	1	2	34.9	35.8	36.0	34.5	35.3	0.0	30.0	0.0	60.0	22.5	30.0	0.0	60.0	0.0	22.5	36.0	16.0	14.0	5.0	3.0	74.0												
7	2	1	33.5	36.4	46.4	40.6	39.2	15.0	70.0	200.0	45.0	82.5	0.0	0.0	210.0	90.0	75.0	31.0	10.0	13.0	14.0	3.0	71.0	145.5	37.0	17.6	18.0	15.0	26.0	17.0	4.6	18.0	16.0	26.0	28.3
9	1	1	40.1	36.1	42.5	37.5	39.1	170.0	75.0	150.0	30.0	106.3	0.0	0.0	0.0	0.0	0.0	23.0	14.0	13.0	5.0	2.0	57.0												
8	3	2	33.7	32.5	36.8	38.5	35.4	0.0	0.0	130.0	125.0	63.8	0.0	0.0	0.0	0.0	0.0	27.0	15.0	10.0	11.0	3.0	66.0												
8	3	1	39.1	35.0	34.2	34.0	35.6	80.0	85.0	40.0	120.0	81.3	30.0	0.0	0.0	0.0	7.5	29.0	13.0	12.0	7.0	2.0	63.0	156.0	53.0	21.8	27.0	19.0	17.0	21.0	6.0	12.0	20.0	25.0	32.9
9	3	2	34.3	32.8	33.5	33.0	33.4	40.0	0.0	50.0	30.0	30.0	0.0	0.0	0.0	0.0	0.0	31.0	11.0	9.0	14.0	3.0	68.0												
9	3	2	31.5	32.8	31.8	31.8	31.9	0.0	0.0	15.0	20.0	8.8	0.0	0.0	0.0	0.0	0.0	20.0	8.0	11.0	13.0	4.0	56.0												
7	1	1	39.1	38.9	79.8	43.6	50.3	170.0	70.0	120.0	60.0	105.0	0.0	0.0	270.0	90.0	90.0	32.0	13.0	10.0	13.0	3.0	71.0												
7	1	1	38.9	40.4	42.4	77.3	49.7	120.0	145.0	150.0	240.0	163.8	60.0	0.0	20.0	240.0	80.0	33.0	15.0	14.0	16.0	4.0	82.0												
8	1	1	35.5	36.9	43.2	38.7	38.6	80.0	115.0	0.0	165.0	90.0	0.0	0.0	0.0	0.0	0.0	24.0	8.0	12.0	15.0	5.0	64.0	158.0	56.0	22.4	24.0	21.0	18.0	24.0	5.2	14.0	15.0	22.0	30.2
8	3	1	34.3	32.6	45.8	34.6	36.8	30.0	15.0	0.0	30.0	18.8	0.0	0.0	120.0	25.0	36.3	25.0	10.0	9.0	11.0	2.0	57.0	160.0	43.0	16.8	15.0	21.0	11.0	20.0	6.1	8.0	10.0	14.0	32.9
8	2	2	33.7	34.1	43.1	31.8	35.7	40.0	15.0	145.0	30.0	57.5	0.0	5.0	0.0	0.0	1.3	34.0	12.0	8.0	9.0	2.0	65.0	152.0	58.0	25.1	32.0	29.0	38.0	18.0	7.7	14.0	10.8	20.0	38.5
9	3	2	38.0	33.6	39.5	40.8	38.0	65.0	0.0	155.0	10.0	57.5	0.0	0.0	0.0	60.0	15.0	14.0	9.0	8.0	10.0	2.0	43.0												
8	3	2	32.2	32.1	31.8	35.0	32.8	0.0	0.0	0.0	75.0	18.8	0.0	0.0	0.0	0.0	0.0	27.0	10.0	12.0	15.0	3.0	67.0												
9	3	2	33.4	32.8	34.3	33.5	33.5	15.0	0.0	70.0	25.0	27.5	0.0	0.0	0.0	0.0	0.0	21.0	10.0	10.0	12.0	6.0	59.0												
9	3	2	34.8	35.5	38.2	35.5	36.0	20.0	0.0	20.0	20.0	15.0	20.0	25.0	85.0	50.0	45.0	14.0	11.0	8.0	8.0	2.0	43.0												
8	1	1	32.0	33.9	41.8	36.8	36.1	0.0	40.0	240.0	50.0	82.5	0.0	0.0	0.0	60.0	15.0	27.0	9.0	9.0	12.0	2.0	59.0												
7	1	1	32.9	32.9	49.6	45.8	40.3	30.0	20.0	90.0	0.0	35.0	0.0	20.0	90.0	90.0	50.0	32.0	11.0	13.0	9.0	3.0	68.0												
9	1	1	35.2	35.6	48.1	41.4	40.1	70.0	60.0	405.0	250.0	196.3	0.0	0.0	0.0	0.0	0.0	18.0	11.0	14.0	7.0	4.0	54.0												
9	1	1	38.8	34.3	30.0	30.5	33.4	50.0	50.0	0.0	0.0	25.0	40.0	0.0	0.0	0.0	10.0	31.0	12.0	8.0	8.0	4.0	63.0												
7	1	2	32.7	34.7	42.8	45.5	38.9	20.0	0.0	150.0	335.0	126.3	0.0	20.0	30.0	0.0	12.5	34.0	15.0	15.0	11.0	5.0	80.0												
7	1	2	35.7	35.5	35.5	40.8	36.9	30.0	0.0	0.0	120.0	37.5	15.0	0.0	0.0	0.0	3.8	24.0	13.0	10.0	7.0	2.0	56.0	138.5	35.0	18.4	12.0	12.0	17.0	16.0	7.8	16.0	18.0	26.0	39.2
8	3	2	35.4	33.9	41.8	35.0	36.5	20.0	0.0	135.0	0.0	38.8	0.0	0.0	0.0	45.0	11.3	24.0	4.0	10.0	10.0	3.0	51.0												
7	3	2	34.5	34.8	34.5	34.4	34.5	10.0	30.0	30.0	15.0	21.3	0.0	0.0	0.0	20.0	5.0	34.0	14.0	6.0	13.0	2.0	69.0												
8	3	2	38.2	32.2	41.2	37.7	37.3	105.0	30.0	135.0	105.0	93.8	0.0	0.0	0.0	0.0	0.0	28.0	15.0	12.0	16.0	8.0	79.0												
9	3	2	33.8	32.5	44.4	29.5	35.1	45.0	0.0	220.0	0.0	66.3	0.0	0.0	0.0	0.0	0.0	25.0	12.0	11.0	14.0	2.0	64.0												
9	3	2	37.5	37.6	37.8	34.8	36.9	60.0	80.0	105.0	65.0	77.5	10.0	0.0	0.0	0.0	2.5	21.0	15.0	12.0	10.0	5.0	63.0												
8	3	2	33.8	33.1	44.4	32.9	36.1	40.0	20.0	135.0	25.0	55.0	0.0	0.0	0.0	0.0	0.0	28.0	15.0	9.0	13.0	5.0	70.0												
7	3	2	33.4	34.1	31.2	30.0	32.2	75.0	75.0	10.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0	27.0	14.0	9.0	13.0	4.0	67.0												
8	1	1	32.9	36.8	47.9	34.0	37.9	0.0	35.0	210.0	0.0	61.3	0.0	0.0	0.0	0.0	0.0	22.0	9.0	7.0	4.0	2.0	44.0												
9	1	2	34.0	33.3	43.3	44.8	38.8	30.0	30.0	90.0	270.0	105.0	0.0	0.0	60.0	0.0	15.0	25.0	7.0	13.0	10.0	3.0	58.0												
9	1	2	44.6	34.3	39.1	37.8	39.0	50.0	0.0	0.0	60.0	27.5	0.0	60.0	10.0	0.0	17.5	28.0	11.0	12.0	9.0	2.0	62.0	158.0	50.0	20.0	22.0	24.0	15.0	19.0	4.6	18.0	16.4	26.0	28.3
9	3	2	32.5	32.3	33.8	30.6	32.3	0.0	0.0	45.0	10.0	13.8	0.0	0.0	0.0	0.0	0.0	32.0	11.0	11.0	12.0	5.0	71.0												
7	3	2	32.1	32.1	32.3	32.3	32.2	0.0	0.0	30.0	20.0	12.5	0.0	0.0	0.0	20.0	5.0	36.0	15.0	9.0	5.0	2.0	67.0												
8	3	2	32.6	33.9	32.6	33.0	33.0	5.0	40.0	20.0	30.0	23.8	0.0	0.0	0.0	0.0	0.0	25.0	9.0	15.0	8.0	3.0	60.0												
8	3	2	32.8	34.9	36.6	34.5	34.7	20.0	70.0	0.0	60.0	37.5	0.0	0.0	0.0	0.0	0.0	27.0	11.0	13.0	13.0	3.0	67.0	163.5	61.0	23.0	22.0	20.0	27.0	17.0	4.0	33.0	26.2	41.0	26.8
8	1	2	33.2	33.3	36.1	31.9	33.6	20.0	45.0	85.0	20.0	42.5	0.0	0.0	0.0	0.0	0.0	29.0	9.0	10.0	9.0	2.0	59.0												
7	1	2	31.0	32.4	36.7	36.7	34.2	0.0	20.0	60.0	120.0	50.0	0.0	0.0	30.0	0.0	7.5	31.0	11.0	14.0	10.0	5.0	71.0												
8	1	2	33.8	33.1	34.6	36.2	34.4	25.0	0.0	75.0	125.0	56.3	0.0	0.0	0.0	0.0	0.0	29.0	12.0	15.0	15.0	3.0	74.0												
8	1	2	32.0	39.5	34.3	39.7	36.4	120.0	20.0	90.0	180.0	102.5	0.0	0.0	0.0	0.0	0.0	35.0	14.0	13.0	16.0	5.0	83.0												
8	1	2	34.2	37.9	34.9	36.8	35.9	10.0	120.0	10.0	20.0	40.0	0.0	0.0	0.0	0.0	0.0	33.0	13.0	13.0	12.0	2.0	73.0	164.0	49.0	18.2	19.0	24.0	18.0	15.0	4.4	23.0	17.4	30.0	27.6
8	1	2	41.4	47.1	46.1	46.3	45.2	0.0	45.0	30.0	110.0	46.3	130.0	90.0	120.0	0.0	85.0	33.0	13.0	16.0	12.0	2.0	76.0	158.0	44.0	17.6	16.0	16.0	25.0	20.0	5.4	18.0	12.4	23.0	31.0
8	3	2	31.5	33.3	32.4	33.4	32.6	5.0	30.0	0.0	45.0	20.0	0.0	0.0	0.0	0.0	0.0	33.0	11.0	12.0	15.0	4.0	75.0												
7	1	2	32.9	32.2	35.5	30.5	32.8	20.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	24.0	10.0	14.0	11.0	2.0	61.0	160.0	50.0	19.5	15.0	14.0	32.0	19.0	4.0	15.0	16.2	24.0	26.8
7	1	1	36.3	38.3	46.0	40.8	40.3	60.0	60.0	0.0	180.0	75.0	0.0	0.0	60.0	0.0	15.0	35.0	10.0	14.0	8.0	2.0	69.0												

8	1	1	55.4	37.6	52.3	46.3	47.9	145.0	140.0	0.0	180.0	116.3	120.0	0.0	180.0	60.0	90.0	36.0	14.0	16.0	16.0	8.0	90.0												
7	1	1	36.2	34.5	41.1	39.9	37.9	95.0	40.0	150.0	15.0	75.0	0.0	15.0	30.0	120.0	41.3	27.0	8.0	12.0	12.0	4.0	63.0												
9	3	2	37.3	46.3	42.4	34.0	40.0	90.0	150.0	165.0	0.0	101.3	0.0	0.0	0.0	0.0	0.0	31.0	13.0	12.0	11.0	5.0	72.0												
8	3	2	34.6	34.8	35.8	32.7	34.5	25.0	40.0	60.0	50.0	43.8	0.0	0.0	0.0	0.0	0.0	29.0	8.0	7.0	13.0	7.0	64.0												
8	3	2	36.5	36.3	39.2	36.1	37.1	30.0	35.0	70.0	80.0	53.8	0.0	0.0	0.0	0.0	0.0	22.0	11.0	11.0	9.0	5.0	58.0												
8	3	2	32.9	33.8	36.2	33.4	34.1	0.0	30.0	75.0	60.0	41.3	0.0	0.0	0.0	0.0	0.0	31.0	14.0	14.0	6.0	2.0	67.0												
9	3	2	34.4	34.1	33.4	32.8	33.7	25.0	15.0	30.0	25.0	23.8	0.0	0.0	0.0	0.0	0.0	31.0	10.0	11.0	15.0	5.0	72.0												
8	3	2	31.9	32.5	33.8	37.3	33.9	10.0	0.0	60.0	150.0	55.0	0.0	0.0	0.0	0.0	0.0	25.0	14.0	10.0	15.0	5.0	69.0												
9	3	2	32.5	33.5	34.6	36.9	34.4	0.0	0.0	20.0	75.0	23.8	0.0	0.0	0.0	0.0	0.0	29.0	10.0	11.0	14.0	3.0	67.0												
9	3	2	34.0	33.5	36.0	33.2	34.1	35.0	15.0	50.0	40.0	35.0	0.0	0.0	0.0	0.0	0.0	24.0	9.0	9.0	13.0	2.0	57.0												
9	3	2	32.8	32.7	32.7	31.1	32.3	0.0	0.0	35.0	15.0	12.5	0.0	0.0	0.0	0.0	0.0	28.0	7.0	12.0	11.0	2.0	60.0												
9	3	2	34.8	32.6	44.5	35.9	37.0	90.0	10.0	250.0	80.0	107.5	0.0	10.0	0.0	0.0	2.5	28.0	12.0	7.0	11.0	2.0	60.0												
9	3	2	37.8	38.1	37.9	35.5	37.3	100.0	90.0	55.0	80.0	81.3	0.0	0.0	0.0	0.0	0.0	36.0	13.0	9.0	7.0	2.0	67.0	160.0	45.0	17.6	21.0	18.0	34.0	20.0	8.4	7.0	6.1	13.0	41.1
9	3	2	34.2	33.8	40.8	36.4	36.3	40.0	30.0	100.0	105.0	68.8	0.0	0.0	0.0	0.0	0.0	28.0	8.0	11.0	13.0	3.0	63.0												
8	3	2	32.2	32.4	33.8	32.2	32.7	10.0	20.0	80.0	30.0	35.0	0.0	0.0	0.0	0.0	0.0	32.0	9.0	9.0	9.0	4.0	63.0												
9	3	2	33.6	34.2	32.3	32.9	33.2	20.0	60.0	60.0	40.0	45.0	0.0	0.0	0.0	0.0	0.0	32.0	15.0	12.0	16.0	7.0	82.0												
7	3	2	34.2	32.0	34.1	29.9	32.5	60.0	20.0	80.0	15.0	43.8	0.0	0.0	0.0	0.0	0.0	33.0	16.0	9.0	11.0	2.0	71.0												
8	2	2	35.3	43.6	42.5	43.0	41.1	60.0	240.0	0.0	300.0	150.0	0.0	30.0	0.0	0.0	7.5	21.0	14.0	10.0	7.0	2.0	54.0												
9	1	2	32.9	34.7	34.9	31.8	33.6	0.0	60.0	80.0	40.0	45.0	0.0	0.0	0.0	0.0	0.0	28.0	12.0	14.0	12.0	4.0	70.0												
8	1	1	32.0	39.3	38.2	33.2	35.7	0.0	180.0	10.0	10.0	50.0	0.0	0.0	50.0	0.0	12.5	27.0	10.0	10.0	6.0	4.0	57.0												
8	3	2	33.3	31.7	33.4	31.1	32.4	20.0	10.0	30.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	23.0	4.0	9.0	8.0	2.0	46.0												
9	3	2	39.8	35.2	40.5	33.8	37.3	140.0	50.0	130.0	80.0	100.0	0.0	0.0	0.0	0.0	0.0	33.0	14.0	10.0	15.0	5.0	77.0												
9	1	2	33.4	35.8	41.0	34.4	36.1	30.0	90.0	135.0	60.0	78.8	0.0	0.0	0.0	0.0	0.0	24.0	10.0	7.0	8.0	4.0	53.0												
8	3	2	37.8	34.8	45.5	41.8	39.9	60.0	60.0	120.0	150.0	97.5	0.0	0.0	60.0	0.0	15.0	32.0	14.0	11.0	13.0	5.0	75.0												
8	1	1	47.4	43.5	48.9	41.3	45.3	130.0	250.0	150.0	150.0	170.0	60.0	0.0	90.0	40.0	47.5	27.0	12.0	12.0	7.0	2.0	60.0												
7	1	1	40.7	37.3	51.8	54.8	46.1	180.0	90.0	270.0	390.0	232.5	0.0	0.0	60.0	30.0	22.5	26.0	13.0	10.0	11.0	3.0	63.0	154.0	37.0	15.6	22.0	23.0	18.0	20.0	7.0	8.0	7.0	12.0	36.4
8	2	2	34.7	35.3	33.0	34.7	34.4	50.0	30.0	30.0	40.0	37.5	0.0	0.0	0.0	0.0	0.0	30.0	12.0	7.0	8.0	2.0	59.0	148.5	35.0	16.0	19.0	35.0	29.0	17.0	8.5	10.0	9.1	17.0	41.1
9	1	2	38.9	37.3	42.0	31.5	37.4	155.0	70.0	180.0	30.0	108.8	0.0	0.0	0.0	0.0	0.0	33.0	10.0	11.0	16.0	3.0	73.0												
9	3	2	32.4	32.3	32.5	30.9	32.1	0.0	0.0	35.0	10.0	11.3	0.0	0.0	0.0	0.0	0.0	29.0	11.0	12.0	10.0	3.0	65.0												
9	3	2	32.8	34.4	43.1	36.6	36.7	0.0	0.0	300.0	115.0	103.8	0.0	0.0	0.0	0.0	0.0	26.0	12.0	8.0	10.0	2.0	58.0												
9	3	2	35.5	35.5	33.6	33.0	34.4	45.0	65.0	30.0	25.0	41.3	0.0	0.0	0.0	0.0	0.0	32.0	11.0	12.0	15.0	5.0	75.0												
8	3	2	37.5	36.0	35.9	38.3	36.9	60.0	90.0	105.0	140.0	98.8	0.0	0.0	0.0	0.0	0.0	33.0	13.0	11.0	8.0	2.0	67.0												
8	3	2	33.8	33.1	36.5	36.8	35.0	25.0	30.0	80.0	125.0	65.0	0.0	0.0	0.0	20.0	5.0	25.0	7.0	12.0	11.0	2.0	57.0												
7	3	2	33.3	33.7	34.8	31.5	33.3	15.0	20.0	60.0	0.0	23.8	0.0	0.0	0.0	0.0	0.0	24.0	14.0	10.0	8.0	7.0	63.0												
8	1	2	27.2	33.7	37.4	39.8	34.5	30.0	15.0	0.0	120.0	41.3	0.0	0.0	0.0	0.0	0.0	21.0	10.0	12.0	10.0	2.0	55.0	160.0	65.0	25.4	26.0	25.0	35.0	16.0	5.1	14.0	24.6	29.0	29.5
8	2	2	32.4	40.3	48.3	41.1	40.5	35.0	155.0	255.0	30.0	118.8	0.0	0.0	75.0	55.0	32.5	26.0	10.0	9.0	12.0	3.0	60.0	153.0	40.0	17.1	19.0	22.0	29.0	19.0	7.5	11.0	9.8	18.0	37.8
7	1	2	32.2	31.8	36.1	30.0	32.5	0.0	0.0	60.0	0.0	15.0	5.0	0.0	0.0	0.0	1.3	36.0	13.0	11.0	15.0	2.0	77.0	152.0	35.0	15.2	17.0	16.0	30.0	15.0	5.2	8.0	9.6	16.0	30.2
8	1	2	37.5	37.5	45.2	37.7	39.5	50.0	40.0	0.0	70.0	40.0	25.0	30.0	120.0	20.0	48.8	32.0	12.0	13.0	12.0	2.0	71.0	158.5	41.0	16.4	21.0	18.0	27.0	21.0	8.8	12.0	4.6	18.0	27.6
8	1	1	37.4	38.5	59.3	42.7	44.5	30.0	175.0	245.0	210.0	165.0	30.0	20.0	140.0	30.0	55.0	26.0	9.0	13.0	6.0	2.0	56.0												
7	1	1	31.8	34.2	55.5	49.7	42.8	20.0	50.0	300.0	10.0	95.0	0.0	0.0	75.0	120.0	48.8	34.0	12.0	10.0	15.0	3.0	74.0												
8	1	1	40.3	45.8	43.8	38.9	42.2	0.0	30.0	0.0	0.0	7.5	60.0	90.0	90.0	60.0	75.0	28.0	10.0	14.0	9.0	2.0	63.0												
8	3	1	33.1	31.8	37.9	40.5	35.8	30.0	0.0	160.0	0.0	47.5	0.0	0.0	0.0	0.0	0.0	36.0	13.0	13.0	13.0	2.0	77.0	160.5	43.0	16.8	15.0	21.0	11.0	20.0	6.1	8.0	10.0	14.0	27.6
8	3	2	33.0	34.0	40.1	33.6	35.2	30.0	65.0	90.0	85.0	67.5	0.0	0.0	60.0	0.0	15.0	27.0	11.0	11.0	11.0	2.0	62.0												
9	2	2	32.2	35.8	34.3	30.2	33.1	0.0	60.0	40.0	5.0	26.3	0.0	0.0	0.0	0.0	0.0	30.0	10.0	10.0	4.0	2.0	56.0												
7	1	2	36.3	31.8	32.9	37.3	34.5	0.0	0.0	0.0	150.0	37.5	30.0	0.0	25.0	0.0	13.8	25.0	10.0	16.0	11.0	2.0	64.0	134.5	30.0	16.7	12.0	11.0	24.0	18.0	4.4	13.0	13.0	21.0	27.6
9	1	2	30.8	33.2	41.5	31.0	34.1	20.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	30.0	14.0	16.0	14.0	4.0	78.0												
7	2	1	32.9	48.6	62.3	35.5	44.8	40.0	260.0	210.0	0.0	127.5	0.0	0.0	30.0	0.0	7.5	26.0	8.0	16.0	13.0	5.0	68.0	145.0	41.0	19.5	20.0	18.0	30.0	25.0	5.1	13.0	9.6	19.0	29.5
8	3	2	34.9	34.9	38.1	31.1	34.8	50.0	40.0	75.0	10.0	43.8	0.0	0.0	0.0	0.0	0.0	34.0	13.0	11.0	16.0	4.0	78.0												
9	1	2	33.4	34.1	38.4	44.5	37.6	10.0	40.0	105.0	450.0	151.3	0.0	0.0	0.0	10.0	2.5	33.0	11.0	14.0	15.0	4.0	77.0	169.5	62.0	21.7	14.0	11.0	14.0	12.0	4.7	24.0	18.0	31.0	28.3
9	1	2	32.9	36.0	49.8	33.8	38.1	0.0	60.0	390.0	20.0	117.5	0.0	0.0	0.0	0.0	0.0	28.0	13.0	8.0	12.0	5.0	66.0	163.0	46.0	17.3	27.0	22.0	33.0	23.0	7.8	17.0	16.0	25.0	27.6
7	1	1	37.8	37.3	69.9	45.8	47.7	30.0	100.0	290.0	380.0	200.0	60.0	0.0	180.0	0.0	60.0	31.0	10.0	10.0	12.0	8.0	71.0												
7	1	2	32.4	31.3	54.9	43.5	40.5	30.0	0.0	380.0	255.0	166.3	0.0	0.0	55.0	0.0	13.8	31.0	13.0	14.0	12.0	4.0	74.0												
9	3	2	32.3	32.3	46.8	44.2	38.9	0.0	0.0	240.0	30.0	67.5	0.0	0.0	0.0	0.0	0.0	9.0	7.0	13.0	4.0	8.0	41.0												
7	1	1	35.5	34.6	47.3	37.3	38.7	60.0	30.0	255.0	150.0	123.8	0.0	0.0	0.0	0.0	0.0	34.0	8.0	13.0	14.0	2.0	71.0												
8	1	1	34.8	41.1	44.7	64.8	46.4	10.0	210.0	290.0	390.0	225.0	20.0	0.0	130.0	120.0	67.5	33.0	14.0	13.0	12.0	3.0	75.0												
9	3	2	33.2	33.5	34.4	35.0	34.0	0.0	20.0	60.0	70.0	37.5	0.0	0.0	0.0	0.0	0.0	25.0	13.0	10.0	9.0	3.0	60.0												
9	1	2	38.3	33.9	41.3	45.3	39.7	30.0	120.0	150.0	210.0	127.5	0.0	0.0	0.0	0.0	0.0	29.0	11.0	8.0	5.0	2.0	55.0	163.0	64.0	24.1	27.0	26.0	40.0	18.0	4.0	19.0	19.2	28.0	26.8
8	3	1	37.5	39.0	43.4	33.8	38.4	120.0	155.0	45.0	30.0	87.5	0.0	0.0	60.0	10.0	17.5	34.0	14.0	10.0	7.0	2.0	67.0	144.0	59.0	28.5	27.0	20.0	24.0	20.0	3.6	24.0	25.0	37.0	26.8
7	3	2	31.3	33.9	37.3	34.5	34.2	15.0	25.0	190.0	60.0	72.5	0.0	0.0	0.0	0.0	0.0	28.0	6.0	8.0	11.0	2.0	55.0												
9	3	2	33.2	33.0	35.8	31.6	33.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	7.5	30.0	13.0	11.0	8.0	2.0	64.0												
8	3	2	32.5	36.3	37.0	31.3	34.1	10.0	90.0	60.0	0.0	40.0	0.0	0.0	30.0	0.0	7.5	34.0	15.0	14.0	16.0	7.0	86.0												
8	1	2	43.0	39.9	56.5	54.5	48.5	160.0	105.0	150.0	150.0	141.3	0.0	0.0	90.0	90.0	45.0	33.0	12.0	11.0	8.0	2.0	66.0	156.0	48.0	19.7	23.0	21.0	34.0	20.0	7.6	25.0	26.2	36.0	38.5
8	1	2	34.1	39.5	54.0	38.8	41.6	120.0	50.0	280.0	200.0	162.5	0.0	0.0	105.0	0.0	26.3	29.0	10.0	11.0	12.0	5.0	67.0												
8	1	2	31.6	49.1	51.0	47.6	44.8	0.0	60.0	150.0	60.0	67.5	0.0	90.0	90.0	90.0	67.5	21.0	7.0	11.0	9.0	2.0	50.0												

7	3	1	36.0	40.4	33.0	35.8	36.3	75.0	180.0	30.0	120.0	101.3	0.0	0.0	0.0	0.0	0.0	34.0	12.0	11.0	10.0	2.0	69.0	148.0	36.0	16.4	17.0	16.0	24.0	18.0	4.2	17.0	15.2	25.0	26.8
9	3	1	32.7	35.4	31.8	30.6	32.6	30.0	70.0	60.0	30.0	47.5	0.0	0.0	0.0	0.0	0.0	24.0	8.0	10.0	12.0	3.0	57.0	168.5	47.0	16.7	29.0	23.0	17.0	21.0	6.1	22.0	21.0	33.0	32.9
8	1	1	37.6	55.3	31.9	35.8	40.1	105.0	120.0	15.0	0.0	60.0	0.0	60.0	0.0	30.0	22.5	33.0	12.0	13.0	13.0	2.0	73.0												
8	3	1	37.5	42.3	48.5	47.5	43.9	120.0	30.0	90.0	120.0	90.0	0.0	60.0	90.0	60.0	52.5	28.0	14.0	13.0	9.0	2.0	66.0	163.5	54.0	20.3	33.0	28.0	28.0	23.0	6.0	19.0	16.0	27.0	32.9
7	3	2	33.8	33.2	36.4	33.4	34.2	20.0	35.0	60.0	20.0	33.8	0.0	0.0	20.0	20.0	10.0	30.0	9.0	14.0	13.0	2.0	68.0												
8	3	2	38.9	37.5	39.8	46.7	40.7	60.0	60.0	30.0	320.0	117.5	0.0	0.0	0.0	0.0	0.0	31.0	13.0	9.0	8.0	2.0	63.0												
7	3	2	46.5	37.0	35.3	41.3	40.0	60.0	120.0	370.0	210.0	190.0	0.0	0.0	0.0	0.0	0.0	29.0	14.0	7.0	13.0	8.0	71.0												
9	3	2	33.8	35.5	35.2	35.5	35.0	30.0	75.0	80.0	75.0	65.0	0.0	0.0	0.0	0.0	0.0	21.0	7.0	10.0	13.0	2.0	53.0												
7	3	2	32.7	33.1	31.3	31.0	32.0	20.0	20.0	0.0	15.0	13.8	0.0	0.0	0.0	0.0	0.0	34.0	12.0	10.0	10.0	2.0	68.0												
9	3	2	33.5	34.6	35.0	33.3	34.1	15.0	45.0	75.0	30.0	41.3	0.0	0.0	0.0	0.0	0.0	35.0	12.0	12.0	14.0	3.0	76.0												
9	1	2	35.6	52.6	49.1	36.9	43.5	20.0	0.0	90.0	30.0	35.0	120.0	0.0	100.0	0.0	55.0	25.0	10.0	10.0	9.0	2.0	56.0												

d1met2	d2met2	satmet2	sunmet2	avemet2	wd1mod	wd2mod	satmod2	sunmod2	avemod2	wd1vig2	wd2vig2	satvig2	sunvig2	avevig2	d12	d22	d32	d42	d52	totalat2	height2	weight2	bmi2	gdom2	gnon2	sar2	supa2	maft2	tri2	calf2	bf2	vo22
35.3	37.4	37.4	31.6	35.4	75.0	115.0	200.0	10.0	100.0	0.0	0.0	0.0	0.0	0.0	36.0	11.0	12.0	16.0	5.0	80.0												
39.5	35.0	44.6	36.8	39.0	320.0	120.0	155.0	70.0	166.3	0.0	0.0	0.0	0.0	0.0	33.0	9.0	6.0	11.0	3.0	62.0	167.5	58.5	20.9	28.9	26.6	24.0	29.0	8.4	15.2	13.6	22.3	41.1
39.3	31.7	33.3	33.6	34.4	90.0	40.0	0.0	0.0	32.5	0.0	0.0	0.0	0.0	0.0	25.0	8.0	11.0	6.0	3.0	53.0												
39.6	40.4	39.3	36.4	38.9	25.0	50.0	180.0	0.0	63.8	90.0	40.0	0.0	40.0	42.5	28.0	13.0	13.0	11.0	4.0	69.0	156.8	45.0	18.5	23.4	21.9	30.0	27.0	9.4	8.8	8.0	13.5	44.5
32.3	33.8	33.8	37.2	34.3	25.0	50.0	60.0	120.0	63.8	0.0	0.0	0.0	0.0	0.0	26.0	10.0	12.0	13.0	5.0	66.0												
33.3	35.2	34.0	31.7	33.5	30.0	20.0	50.0	20.0	30.0	0.0	30.0	0.0	0.0	7.5	20.0	9.0	8.0	12.0	3.0	52.0												
35.5	38.2	32.5	30.8	34.2	25.0	0.0	40.0	60.0	31.3	0.0	0.0	0.0	0.0	0.0	9.0	4.0	7.0	4.0	2.0	26.0												
55.3	64.5	41.1	41.4	50.6	30.0	780.0	60.0	120.0	247.5	300.0	0.0	60.0	0.0	90.0	34.0	9.0	14.0	14.0	4.0	75.0	163.0	58.5	22.0	22.8	20.8	18.5	27.0	5.2	21.6	21.2	31.3	30.2
38.0	35.8	38.5	35.3	36.9	50.0	90.0	140.0	80.0	90.0	60.0	0.0	0.0	0.0	15.0	28.0	12.0	14.0	6.0	3.0	63.0												
33.4	33.2	35.5	31.6	33.4	65.0	30.0	30.0	5.0	32.5	0.0	0.0	0.0	0.0	0.0	19.0	9.0	7.0	7.0	2.0	44.0												
31.7	33.3	41.0	30.4	34.1	0.0	0.0	30.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	19.0	6.0	11.0	7.0	4.0	47.0	169.5	64.0	22.4	16.8	13.9	15.0	15.0	4.4	20.6	21.0	30.7	27.6
50.8	46.3	36.8	35.7	42.4	120.0	210.0	60.0	0.0	97.5	0.0	0.0	0.0	0.0	0.0	21.0	7.0	12.0	13.0	2.0	55.0	161.5	46.5	17.9	16.5	19.0	33.0	23.0	5.6	13.0	9.4	18.5	31.8
31.9	31.6	32.7	30.7	31.7	20.0	10.0	50.0	20.0	25.0	0.0	0.0	0.0	0.0	0.0	24.0	10.0	6.0	5.0	3.0	48.0												
35.0	45.0	32.5	32.1	36.1	100.0	130.0	15.0	10.0	63.8	30.0	0.0	0.0	0.0	7.5	20.0	11.0	15.0	4.0	3.0	53.0												
37.4	35.8	43.3	38.0	38.6	120.0	50.0	230.0	135.0	133.8	0.0	0.0	25.0	10.0	8.8	25.0	8.0	10.0	7.0	2.0	52.0												
40.0	33.8	33.0	33.2	35.0	120.0	130.0	20.0	15.0	71.3	0.0	0.0	0.0	0.0	0.0	35.0	9.0	13.0	11.0	5.0	73.0												
31.5	32.1	36.9	33.4	33.5	0.0	5.0	110.0	0.0	28.8	0.0	15.0	0.0	20.0	8.8	28.0	12.0	12.0	16.0	7.0	75.0	146.0	30.0	14.1	12.4	11.7	33.0	16.0	4.8	9.0	9.6	16.7	29.5
35.3	33.7	48.3	39.7	39.3	180.0	70.0	70.0	45.0	91.3	115.0	65.0	0.0	0.0	45.0	30.0	9.0	11.0	14.0	3.0	67.0	170.0	56.5	19.6	38.2	36.7	32.0	25.0	8.2	12.8	19.6	24.5	40.5
43.1	43.6	37.3	31.7	38.9	105.0	80.0	75.0	20.0	70.0	90.0	115.0	0.0	0.0	51.3	32.0	9.0	10.0	14.0	3.0	68.0												
34.9	35.3	38.1	32.7	35.2	15.0	65.0	20.0	25.0	31.3	0.0	0.0	0.0	0.0	0.0	24.0	8.0	7.0	11.0	5.0	55.0												
33.5	31.4	32.8	30.0	31.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	12.0	12.0	11.0	2.0	59.0												
36.2	40.8	44.1	40.0	40.3	80.0	115.0	200.0	135.0	132.5	0.0	0.0	0.0	0.0	0.0	28.0	9.0	8.0	8.0	5.0	58.0												
33.3	33.4	37.2	34.3	34.6	5.0	40.0	40.0	70.0	38.8	0.0	0.0	55.0	0.0	13.8	31.0	11.0	8.0	10.0	4.0	64.0												
40.5	36.7	41.4	56.3	43.7	130.0	360.0	210.0	105.0	201.3	0.0	120.0	0.0	0.0	30.0	29.0	6.0	9.0	11.0	6.0	61.0	160.5	52.5	20.3	26.9	22.1	27.0	23.0	7.4	12.4	11.6	18.6	37.8
39.3	33.4	32.3	33.4	34.6	110.0	20.0	0.0	10.0	35.0	0.0	0.0	0.0	0.0	0.0	36.0	13.0	16.0	14.0	5.0	84.0												
35.1	34.8	46.3	29.7	36.5	60.0	40.0	0.0	0.0	25.0	0.0	5.0	180.0	0.0	46.3	34.0	13.0	10.0	11.0	2.0	70.0												
35.5	36.7	38.2	36.8	36.8	15.0	70.0	110.0	100.0	73.8	0.0	0.0	0.0	0.0	0.0	34.0	10.0	11.0	14.0	8.0	77.0												
32.4	32.0	33.7	32.5	32.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	12.0	13.0	11.0	3.0	70.0												
34.8	33.1	39.3	31.5	34.7	180.0	0.0	0.0	0.0	45.0	0.0	0.0	30.0	10.0	10.0	17.0	8.0	10.0	10.0	3.0	48.0												
33.5	35.7	37.9	41.3	37.1	90.0	180.0	20.0	60.0	87.5	0.0	0.0	0.0	0.0	0.0	15.0	4.0	10.0	4.0	2.0	35.0												
36.1	34.0	37.2	35.6	35.7	15.0	20.0	30.0	80.0	36.3	0.0	0.0	0.0	0.0	0.0	24.0	9.0	13.0	9.0	4.0	59.0												
32.3	32.3	32.5	34.1	32.8	0.0	0.0	0.0	20.0	5.0	0.0	0.0	0.0	0.0	0.0	33.0	12.0	11.0	13.0	2.0	71.0												
34.0	35.1	37.2	31.1	34.3	110.0	10.0	50.0	35.0	51.3	30.0	30.0	0.0	0.0	15.0	32.0	12.0	9.0	5.0	2.0	60.0												
32.6	32.7	37.2	35.8	34.6	30.0	115.0	30.0	30.0	51.3	0.0	0.0	0.0	0.0	0.0	18.0	5.0	12.0	10.0	5.0	50.0	167.5	58.0	20.7	25.9	23.0	30.0	20.0	4.4	26.6	24.2	36.2	27.6
36.2	33.8	38.3	35.4	35.9	45.0	30.0	60.0	20.0	38.8	0.0	0.0	0.0	0.0	0.0	29.0	12.0	12.0	13.0	3.0	69.0												
36.3	34.3	34.1	35.0	34.9	115.0	75.0	55.0	60.0	76.3	0.0	0.0	0.0	0.0	0.0	34.0	7.0	13.0	7.0	8.0	69.0												
38.0	39.0	39.3	35.0	37.8	125.0	95.0	60.0	15.0	73.8	0.0	15.0	25.0	0.0	10.0	35.0	8.0	14.0	15.0	5.0	77.0												
33.3	36.5	37.6	39.9	36.8	0.0	45.0	120.0	195.0	90.0	0.0	0.0	0.0	0.0	0.0	25.0	4.0	12.0	8.0	3.0	52.0												
40.6	33.2	35.3	33.1	35.6	55.0	20.0	15.0	20.0	27.5	10.0	0.0	0.0	0.0	2.5	34.0	11.0	12.0	10.0	5.0	72.0	167.0	64.0	22.9	27.2	27.7	21.0	22.0	8.2	17.6	17.0	26.5	40.5
36.4	41.3	46.8	33.0	39.4	140.0	20.0	20.0	120.0	75.0	0.0	0.0	0.0	0.0	0.0	27.0	8.0	10.0	5.0	2.0	52.0												
36.9	34.3	33.2	34.1	34.6	105.0	80.0	0.0	0.0	46.3	0.0	0.0	20.0	20.0	10.0	25.0	10.0	12.0	14.0	6.0	67.0	159.5	56.0	22.2	20.4	20.2	28.0	11.0	5.2	18.6	23.2	30.7	30.2
33.0	31.8	30.4	32.0	31.8	15.0	25.0	20.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	12.0	6.0	14.0	7.0	4.0	43.0	161.0	47.5	18.3	20.2	18.4	24.0	20.0	4.8	22.2	18.4	30.1	28.3
35.9	35.3	39.1	33.6	36.0	30.0	30.0	40.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	29.0	4.0	10.0	9.0	2.0	54.0												

32.3	32.0	45.3	29.5	34.8	90.0	0.0	0.0	0.0	22.5	0.0	0.0	0.0	0.0	0.0	16.0	11.0	12.0	7.0	2.0	48.0												
34.3	36.4	36.8	37.5	36.2	60.0	65.0	20.0	0.0	36.3	0.0	5.0	60.0	0.0	16.3	21.0	11.0	10.0	10.0	2.0	54.0												
41.5	38.3	38.1	34.1	38.0	0.0	15.0	150.0	60.0	56.3	120.0	45.0	0.0	0.0	41.3	35.0	11.0	13.0	16.0	8.0	83.0												
36.9	41.7	45.2	38.8	40.6	95.0	120.0	15.0	50.0	70.0	75.0	0.0	0.0	90.0	41.3	28.0	12.0	12.0	13.0	2.0	67.0	166.5	58.0	20.9	31.2	30.9	32.0	21.0	5.8	18.6	20.6	28.9	31.8
37.8	34.7	40.2	33.3	36.5	65.0	70.0	80.0	30.0	61.3	50.0	0.0	75.0	0.0	31.3	35.0	7.0	13.0	12.0	3.0	70.0												
33.8	33.8	38.3	36.9	35.7	40.0	35.0	65.0	40.0	45.0	0.0	0.0	0.0	0.0	0.0	30.0	11.0	14.0	14.0	7.0	76.0												
37.6	35.0	34.5	37.6	36.2	15.0	65.0	90.0	30.0	50.0	60.0	0.0	0.0	0.0	15.0	35.0	13.0	12.0	13.0	3.0	76.0												
35.8	37.8	38.2	39.1	37.2	75.0	115.0	120.0	200.0	127.5	0.0	0.0	10.0	0.0	2.5	34.0	7.0	14.0	10.0	2.0	67.0												
37.3	44.3	49.6	45.1	44.1	10.0	140.0	260.0	200.0	152.5	60.0	60.0	0.0	0.0	30.0	36.0	16.0	16.0	14.0	5.0	87.0												
41.8	32.8	46.3	31.8	38.1	0.0	0.0	300.0	0.0	75.0	105.0	0.0	0.0	0.0	26.3	36.0	12.0	16.0	16.0	3.0	83.0												
32.8	32.4	38.8	33.2	34.3	0.0	40.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	17.0	10.0	7.0	13.0	2.0	49.0												
45.7	34.2	41.5	39.3	40.2	230.0	50.0	30.0	210.0	130.0	55.0	0.0	120.0	0.0	43.8	28.0	9.0	13.0	13.0	5.0	68.0												
37.6	33.4	31.3	31.3	33.4	30.0	0.0	0.0	0.0	7.5	50.0	0.0	0.0	0.0	12.5	31.0	12.0	14.0	11.0	6.0	74.0	158.5	56.0	22.2	31.1	30.1	25.0	25.0	8.2	9.8	10.4	15.7	40.5
33.5	39.3	33.7	32.6	34.8	35.0	180.0	0.0	0.0	53.8	0.0	0.0	0.0	0.0	0.0	32.0	14.0	13.0	13.0	3.0	75.0												
36.3	40.6	35.8	33.3	36.5	90.0	180.0	90.0	70.0	107.5	0.0	0.0	0.0	0.0	0.0	29.0	9.0	12.0	10.0	7.0	67.0												
34.1	32.8	33.0	36.5	34.1	40.0	0.0	50.0	10.0	25.0	0.0	0.0	0.0	0.0	0.0	32.0	10.0	11.0	12.0	2.0	67.0												
33.7	32.5	42.3	36.5	36.2	10.0	10.0	210.0	120.0	87.5	0.0	0.0	0.0	0.0	0.0	32.0	10.0	10.0	8.0	2.0	62.0	155.5	41.5	17.2	21.0	18.6	15.0	26.0	6.4	14.6	15.8	23.0	34.3
31.5	34.8	34.1	33.0	33.4	0.0	50.0	15.0	50.0	28.8	0.0	0.0	0.0	0.0	0.0	23.0	11.0	12.0	12.0	5.0	63.0												
32.0	32.3	40.7	40.8	36.4	250.0	240.0	0.0	0.0	122.5	0.0	0.0	0.0	0.0	0.0	10.0	4.0	12.0	7.0	2.0	35.0												
33.2	34.8	33.8	33.3	33.7	10.0	45.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	27.0	12.0	12.0	10.0	3.0	64.0												
35.0	36.0	34.7	33.4	34.8	75.0	55.0	35.0	15.0	45.0	0.0	0.0	0.0	0.0	0.0	31.0	14.0	13.0	8.0	4.0	70.0												
32.6	33.9	36.8	33.3	34.1	0.0	10.0	25.0	40.0	18.8	0.0	0.0	0.0	0.0	0.0	32.0	13.0	13.0	16.0	8.0	82.0	152.5	60.0	26.0	27.1	19.5	28.0	19.0	4.1	25.6	26.6	36.8	26.8
35.9	46.2	42.9	37.9	40.7	55.0	60.0	165.0	70.0	87.5	0.0	60.0	0.0	0.0	15.0	26.0	11.0	7.0	8.0	3.0	55.0	144.5	42.0	20.3	12.6	12.8	6.0	23.0	5.9	17.0	17.4	26.0	32.9
41.2	33.8	45.5	47.5	42.0	210.0	300.0	40.0	55.0	161.3	0.0	0.0	120.0	0.0	30.0	25.0	9.0	7.0	12.0	2.0	55.0	154.5	40.5	16.9	27.6	25.2	15.0	25.0	9.2	7.2	8.2	12.0	43.9
36.1	32.8	33.9	30.2	33.3	20.0	30.0	50.0	0.0	25.0	50.0	0.0	0.0	0.0	12.5	31.0	10.0	12.0	15.0	4.0	72.0	163.6	57.0	21.2	15.6	17.5	18.0	21.0	5.4	14.8	17.0	24.5	31.0
32.7	33.8	43.8	46.9	39.3	5.0	35.0	220.0	325.0	146.3	0.0	0.0	25.0	0.0	6.3	28.0	9.0	10.0	7.0	2.0	56.0												
37.7	37.4	42.5	35.9	38.4	130.0	130.0	120.0	135.0	128.8	0.0	0.0	60.0	0.0	15.0	32.0	11.0	13.0	10.0	3.0	69.0												
45.2	41.5	36.4	30.5	38.4	145.0	100.0	0.0	0.0	61.3	0.0	0.0	0.0	0.0	0.0	33.0	6.0	9.0	14.0	2.0	64.0												
33.5	35.5	37.8	34.1	35.2	0.0	20.0	45.0	30.0	23.8	20.0	20.0	15.0	0.0	13.8	25.0	12.0	12.0	11.0	3.0	63.0												
32.4	38.3	38.9	30.4	35.0	0.0	140.0	30.0	0.0	42.5	0.0	0.0	50.0	0.0	12.5	28.0	9.0	13.0	13.0	2.0	65.0	162.5	51.0	19.5	31.1	31.4	24.0	23.0	4.6	8.2	11.2	15.0	28.3
32.5	32.0	31.5	33.5	32.4	0.0	60.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	22.0	4.0	11.0	10.0	8.0	55.0												
36.4	35.1	32.1	36.4	35.0	70.0	90.0	0.0	0.0	40.0	0.0	0.0	0.0	60.0	15.0	27.0	10.0	15.0	10.0	4.0	66.0	161.0	86.5	33.4	23.3	26.9	18.0	11.0	4.4	34.0	35.2	47.2	27.6
33.6	39.0	35.3	34.5	35.6	0.0	5.0	50.0	10.0	16.3	0.0	70.0	0.0	10.0	20.0	22.0	8.0	8.0	14.0	2.0	54.0	155.0	70.0	29.1	28.0	20.2	29.0	10.0	4.2	29.2	30.0	41.1	26.8
33.8	34.5	35.5	33.6	34.3	0.0	60.0	50.0	30.0	35.0	0.0	10.0	0.0	0.0	2.5	26.0	7.0	11.0	13.0	4.0	61.0	163.5	50.0	18.8	18.5	16.5	18.5	17.0	6.2	11.8	11.4	19.1	33.6
54.7	50.3	36.2	32.4	43.4	180.0	420.0	70.0	0.0	167.5	160.0	0.0	0.0	0.0	45.0	34.0	6.0	15.0	15.0	3.0	73.0												
32.6	35.1	41.1	30.9	34.9	0.0	0.0	0.0	60.0	15.0	120.0	0.0	0.0	0.0	30.0	20.0	5.0	9.0	13.0	3.0	50.0												
39.8	34.8	35.9	37.4	37.0	90.0	30.0	60.0	30.0	52.5	30.0	15.0	30.0	30.0	26.3	32.0	13.0	14.0	9.0	2.0	70.0												
36.1	36.5	40.5	37.4	37.6	90.0	85.0	130.0	0.0	76.3	0.0	0.0	15.0	0.0	3.8	16.0	7.0	12.0	8.0	2.0	45.0												
41.0	42.3	37.4	46.7	41.8	120.0	165.0	80.0	120.0	121.3	60.0	0.0	0.0	0.0	15.0	35.0	8.0	12.0	13.0	3.0	71.0												
37.1	37.3	39.9	36.5	37.7	130.0	110.0	150.0	85.0	118.8	0.0	0.0	10.0	0.0	2.5	31.0	11.0	14.0	13.0	2.0	71.0												
37.7	37.9	47.5	43.1	41.6	330.0	210.0	100.0	115.0	188.8	0.0	0.0	0.0	0.0	0.0	33.0	15.0	16.0	13.0	4.0	81.0												

37.8	39.6	45.0	36.5	39.7	30.0	70.0	100.0	115.0	78.8	60.0	20.0	85.0	0.0	41.3	36.0	8.0	11.0	13.0	2.0	70.0												
32.6	35.1	32.8	32.9	33.4	0.0	40.0	40.0	50.0	32.5	0.0	0.0	0.0	0.0	0.0	27.0	8.0	11.0	11.0	2.0	59.0												
35.5	33.7	46.0	44.0	39.8	55.0	45.0	45.0	60.0	51.3	0.0	0.0	0.0	0.0	0.0	29.0	14.0	13.0	11.0	4.0	71.0												
36.3	37.0	43.2	38.8	38.8	60.0	60.0	360.0	100.0	145.0	0.0	15.0	0.0	0.0	3.8	29.0	8.0	14.0	7.0	6.0	64.0												
41.2	37.5	38.0	41.9	39.6	60.0	60.0	150.0	240.0	127.5	60.0	0.0	0.0	0.0	15.0	29.0	12.0	9.0	8.0	4.0	62.0												
41.2	33.1	39.9	35.3	37.4	60.0	15.0	15.0	10.0	25.0	60.0	0.0	30.0	30.0	30.0	24.0	6.0	9.0	10.0	4.0	53.0												
32.8	34.0	37.2	33.7	34.4	0.0	0.0	10.0	60.0	17.5	0.0	0.0	0.0	0.0	0.0	25.0	9.0	10.0	10.0	4.0	58.0	163.5	65.0	24.5	31.5	27.3	26.0	19.0	4.2	17.2	15.6	25.2	26.8
32.1	31.6	42.3	36.1	35.5	30.0	60.0	0.0	0.0	22.5	0.0	0.0	0.0	0.0	0.0	30.0	16.0	8.0	15.0	4.0	73.0												
34.0	32.3	30.6	30.1	31.7	50.0	50.0	0.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	30.0	12.0	13.0	13.0	7.0	75.0	165.0	84.0	30.9			27.0	15.0	4.2	26.0	23.2	35.0	26.8
32.0	34.5	32.4	37.3	34.1	0.0	0.0	0.0	120.0	30.0	0.0	60.0	0.0	0.0	15.0	9.0	4.0	12.0	7.0	3.0	35.0												
29.5	29.5	36.0	35.4	32.6	0.0	0.0	70.0	70.0	35.0	0.0	0.0	0.0	0.0	0.0	9.0	4.0	6.0	7.0	6.0	32.0												
45.4	41.3	37.8	35.0	39.9	300.0	30.0	110.0	0.0	110.0	0.0	0.0	0.0	0.0	0.0	22.0	5.0	10.0	8.0	5.0	50.0												
37.8	36.5	52.3	42.5	42.3	30.0	30.0	360.0	30.0	112.5	0.0	0.0	0.0	0.0	0.0	26.0	13.0	12.0	7.0	2.0	60.0	157.5	64.0	26.0	24.0	28.7	20.0	25.0	6.2	24.8	18.0	31.3	33.6
33.0	33.0	38.4	33.8	34.5	135.0	90.0	30.0	30.0	71.3	30.0	0.0	0.0	0.0	7.5	28.0	9.0	12.0	10.0	5.0	64.0	156.5	40.0	16.3	21.4	20.2	23.0	23.0	7.4	10.2	10.4	16.4	37.8
44.4	37.8	40.1	38.1	40.1	60.0	35.0	65.0	25.0	46.3	120.0	15.0	0.0	30.0	41.3	33.0	10.0	8.0	7.0	6.0	64.0												
32.7	32.0	30.8	31.5	31.7	0.0	0.0	0.0	30.0	7.5	0.0	0.0	0.0	0.0	0.0	31.0	10.0	10.0	12.0	2.0	65.0												
37.6	34.1	36.3	37.0	36.2	30.0	30.0	60.0	0.0	30.0	50.0	0.0	0.0	60.0	27.5	34.0	11.0	13.0	9.0	3.0	70.0	168.9	59.0	20.7	33.1	30.0	21.0	25.0	8.6	5.4	6.0	9.1	41.8
33.3	33.4	42.0	36.3	36.2	30.0	30.0	185.0	100.0	86.3	0.0	0.0	20.0	0.0	5.0	36.0	16.0	13.0	4.0	2.0	71.0												
31.2	32.0	35.7	29.7	32.1	10.0	30.0	60.0	0.0	25.0	0.0	0.0	0.0	0.0	0.0	31.0	13.0	16.0	10.0	5.0	75.0	162.8	57.0	21.5	35.7	35.5	30.0	28.0	7.0	8.6	10.2	15.0	36.4
38.0	37.0	39.2	40.1	38.6	60.0	120.0	165.0	280.0	156.3	50.0	0.0	0.0	0.0	12.5	23.0	7.0	10.0	8.0	2.0	50.0	157.5	46.0	18.7	16.7	14.8	17.0	18.0	5.4	12.4	15.0	21.6	31.0
31.0	31.4	39.1	33.0	33.6	5.0	0.0	150.0	5.0	40.0	0.0	0.0	0.0	0.0	0.0	33.0	6.0	10.0	13.0	2.0	64.0												
35.8	36.3	35.0	34.3	35.3	0.0	10.0	30.0	30.0	17.5	0.0	0.0	20.0	0.0	5.0	19.0	7.0	11.0	9.0	4.0	50.0												
32.5	32.1	41.8	31.1	34.4	0.0	0.0	30.0	0.0	7.5	0.0	0.0	120.0	0.0	30.0	21.0	11.0	8.0	9.0	2.0	51.0												
34.3	33.8	37.9	39.8	36.4	50.0	60.0	0.0	0.0	27.5	0.0	0.0	0.0	120.0	30.0	31.0	12.0	8.0	11.0	2.0	64.0	152.0	42.0	18.2	21.0	22.9	30.0	26.0	8.2	10.6	11.2	17.2	40.5
32.3	31.9	36.2	33.4	33.5	0.0	10.0	30.0	20.0	15.0	0.0	0.0	0.0	0.0	0.0	24.0	10.0	11.0	10.0	2.0	57.0												
33.4	32.6	36.0	37.3	34.8	30.0	0.0	60.0	0.0	22.5	0.0	0.0	0.0	90.0	22.5	26.0	10.0	10.0	13.0	5.0	64.0												
37.2	35.6	46.3	34.6	38.4	40.0	70.0	230.0	35.0	93.8	20.0	0.0	30.0	15.0	16.3	33.0	15.0	12.0	12.0	4.0	76.0	161.4	55.0	21.2	22.1	19.5	21.0	25.0	6.2	14.6	14.8	22.8	33.6
39.8	38.3	36.7	39.6	38.6	0.0	90.0	20.0	120.0	57.5	90.0	0.0	0.0	0.0	22.5	34.0	12.0	12.0	14.0	5.0	77.0	149.0	49.0	22.1	30.0	27.2	42.0	20.0	9.6	19.8	18.6	28.3	45.2
36.9	35.8	42.6	35.3	37.6	70.0	90.0	60.0	15.0	58.8	0.0	0.0	0.0	0.0	0.0	31.0	14.0	12.0	10.0	4.0	71.0	165.0	57.5	21.1	24.2	19.6	22.0	21.0	7.4	17.4	14.2	24.6	37.8
31.8	33.5	30.8	33.1	32.3	0.0	0.0	25.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	11.0	4.0	12.0	15.0	2.0	44.0	149.8	45.0	20.0	17.5	15.5	24.0	21.0	4.2	19.0	21.2	29.5	26.8
33.8	35.8	39.9	37.4	36.7	60.0	100.0	85.0	95.0	85.0	0.0	0.0	0.0	30.0	7.5	25.0	12.0	7.0	10.0	2.0	56.0												
35.4	32.7	38.4	40.2	36.7	40.0	5.0	150.0	90.0	71.3	0.0	0.0	0.0	0.0	0.0	29.0	13.0	12.0	13.0	5.0	72.0												
42.8	36.2	36.9	33.2	37.3	225.0	90.0	100.0	15.0	107.5	0.0	0.0	0.0	0.0	0.0	30.0	9.0	16.0	16.0	3.0	74.0												
41.9	33.8	34.0	32.0	35.4	0.0	30.0	90.0	0.0	30.0	60.0	0.0	0.0	0.0	15.0	34.0	11.0	12.0	14.0	5.0	76.0	165.0	52.5	19.3	18.2	17.9	32.5	23.0	8.8	9.0	13.6	19.1	42.4
50.1	44.9	37.2	35.7	42.0	225.0	310.0	100.0	45.0	170.0	60.0	0.0	0.0	0.0	15.0	11.0	8.0	16.0	12.0	2.0	49.0												
35.1	33.4	34.0	37.6	35.0	60.0	0.0	0.0	120.0	45.0	0.0	0.0	0.0	0.0	0.0	29.0	7.0	11.0	7.0	2.0	56.0	169.5	61.0	21.4	31.5	36.0	24.0	25.0	5.2	12.8	8.2	17.9	30.2
34.9	35.8	45.3	30.0	36.5	60.0	60.0	300.0	0.0	105.0	0.0	0.0	0.0	0.0	0.0	21.0	6.0	11.0	11.0	3.0	52.0												
37.3	42.2	42.1	32.0	38.4	15.0	30.0	90.0	0.0	33.8	60.0	65.0	60.0	0.0	46.3	28.0	11.0	9.0	14.0	4.0	66.0	146.5	35.0	16.4	19.3	18.2	26.0	29.0	8.5	7.2	5.8	10.6	41.1
33.4	34.3	37.0	35.1	35.0	40.0	30.0	50.0	15.0	33.8	0.0	0.0	0.0	0.0	0.0	33.0	16.0	13.0	16.0	2.0	80.0												
37.3	40.4	37.0	37.8	38.1	0.0	50.0	130.0	0.0	45.0	70.0	40.0	0.0	55.0	41.3	30.0	12.0	13.0	13.0	5.0	73.0	158.7	46.0	18.2	27.3	23.4	28.0	28.0	9.4	6.6	5.8	9.8	44.5

32.8	33.3	37.1	36.4	34.9	25.0	25.0	45.0	20.0	28.8	0.0	0.0	0.0	0.0	0.0	34.0	13.0	9.0	16.0	6.0	78.0												
39.9	39.0	41.5	38.1	39.6	135.0	100.0	125.0	60.0	105.0	30.0	25.0	30.0	0.0	21.3	34.0	13.0	15.0	11.0	3.0	76.0												
34.0	37.5	36.2	35.5	35.8	30.0	60.0	60.0	35.0	46.3	0.0	0.0	0.0	0.0	0.0	9.0	4.0	13.0	12.0	2.0	40.0	164.0	79.0	29.4	22.6	15.2			4.2	28.0	25.0	37.4	26.8
32.8	35.5	46.3	37.5	38.0	360.0	90.0	0.0	60.0	127.5	0.0	0.0	0.0	0.0	0.0	27.0	9.0	7.0	10.0	2.0	55.0												
31.9	33.0	32.0	33.9	32.7	0.0	5.0	35.0	0.0	10.0	0.0	10.0	0.0	30.0	10.0	27.0	6.0	8.0	11.0	2.0	54.0	149.7	36.0	16.2	14.7	13.7	26.0	20.0	4.8	11.0	12.2	19.1	29.5
36.5	38.9	35.8	36.8	37.0	0.0	195.0	50.0	105.0	87.5	0.0	0.0	0.0	0.0	0.0	25.0	9.0	10.0	11.0	2.0	57.0												
34.5	35.1	44.8	44.8	39.8	55.0	30.0	270.0	175.0	132.5	0.0	0.0	0.0	60.0	15.0	27.0	7.0	13.0	13.0	2.0	62.0												
32.1	40.1	34.0	34.3	35.1	0.0	90.0	0.0	60.0	37.5	0.0	60.0	0.0	0.0	15.0	31.0	9.0	13.0	9.0	3.0	65.0												
41.0	31.9	36.0	32.6	35.4	150.0	10.0	80.0	0.0	60.0	0.0	0.0	0.0	0.0	0.0	28.0	5.0	7.0	9.0	3.0	52.0												
34.8	34.9	39.0	35.3	36.0	90.0	90.0	0.0	0.0	45.0	0.0	0.0	0.0	0.0	0.0	23.0	7.0	14.0	10.0	2.0	56.0												
38.6	33.8	42.5	42.0	39.2	50.0	50.0	0.0	0.0	25.0	60.0	0.0	150.0	150.0	90.0	29.0	7.0	9.0	10.0	2.0	57.0	147.0	47.5	22.0	20.0	16.4	21.0	27.0	4.8	14.8	15.8	23.8	28.3
32.6	34.6	40.0	32.8	35.0	150.0	40.0	5.0	45.0	60.0	0.0	0.0	0.0	0.0	0.0	24.0	8.0	8.0	5.0	3.0	48.0	157.5	49.5	20.0	21.4	20.6	21.0	22.0	6.4	24.6	24.8	35.0	34.3
32.8	32.9	35.3	33.4	33.6	0.0	0.0	65.0	20.0	21.3	0.0	0.0	0.0	0.0	0.0	29.0	12.0	11.0	13.0	3.0	68.0												
32.0	34.0	46.7	36.4	37.3	30.0	60.0	240.0	100.0	107.5	0.0	0.0	40.0	0.0	10.0	27.0	11.0	13.0	8.0	4.0	63.0												
36.6	43.9	44.6	47.8	43.2	120.0	120.0	110.0	75.0	106.3	90.0	150.0	0.0	80.0	80.0	36.0	13.0	10.0	12.0	5.0	76.0												
37.5	38.3	36.2	33.3	36.3	75.0	60.0	95.0	85.0	78.8	25.0	45.0	25.0	0.0	23.8	26.0	7.0	14.0	12.0	6.0	65.0												
34.5	33.1	37.4	32.3	34.3	135.0	30.0	45.0	15.0	56.3	0.0	0.0	0.0	0.0	0.0	17.0	7.0	8.0	12.0	7.0	51.0												
51.3	45.1	39.1	47.8	45.8	75.0	180.0	20.0	45.0	80.0	80.0	0.0	60.0	120.0	65.0	26.0	9.0	7.0	9.0	2.0	53.0	119.5	52.0	36.7	19.6	24.2	28.0	21.0	7.4	9.4	9.6	16.7	37.8
31.0	31.0	37.9	34.6	33.6	0.0	0.0	30.0	0.0	7.5	0.0	0.0	45.0	40.0	21.3	34.0	13.0	10.0	11.0	6.0	74.0												
33.6	36.0	43.3	30.8	35.9	40.0	30.0	90.0	0.0	40.0	0.0	20.0	60.0	0.0	20.0	30.0	9.0	13.0	13.0	4.0	69.0	146.0	40.0	18.8	15.0	16.6	28.5	23.0	7.1	9.0	11.4	15.7	36.4
33.6	34.0	37.6	32.7	34.5	135.0	35.0	0.0	10.0	45.0	0.0	0.0	0.0	0.0	0.0	28.0	9.0	12.0	13.0	2.0	64.0												
34.6	32.7	39.1	33.2	34.9	30.0	20.0	75.0	35.0	40.0	0.0	0.0	20.0	0.0	5.0	28.0	12.0	9.0	8.0	2.0	59.0	152.5	40.0	17.3	19.6	19.7	28.0	17.0	4.6	12.8	9.4	18.5	28.3
42.7	41.6	42.2	36.2	40.7	100.0	0.0	250.0	90.0	110.0	0.0	0.0	0.0	60.0	15.0	25.0	8.0	8.0	9.0	2.0	52.0												
34.6	34.8	34.3	48.8	38.1	80.0	60.0	0.0	375.0	128.8	0.0	0.0	30.0	20.0	12.5	32.0	9.0	15.0	15.0	5.0	76.0												
31.5	33.9	29.5	31.8	31.7	0.0	45.0	0.0	30.0	18.8	0.0	0.0	0.0	0.0	0.0	36.0	10.0	10.0	16.0	8.0	80.0												
35.1	40.6	44.0	54.4	43.5	90.0	0.0	55.0	185.0	82.5	90.0	165.0	0.0	0.0	63.8	33.0	15.0	15.0	14.0	2.0	79.0	163.5	58.0	21.7	25.2	24.6	44.0	23.0	4.6	18.8	20.6	28.9	28.3
32.9	32.4	34.5	35.8	33.9	60.0	60.0	0.0	0.0	30.0	0.0	0.0	0.0	0.0	0.0	21.0	6.0	13.0	10.0	5.0	55.0												
46.2	43.7	41.6	35.6	41.8	300.0	330.0	40.0	40.0	177.5	0.0	0.0	60.0	0.0	15.0	26.0	8.0	10.0	8.0	2.0	54.0	161.0	56.0	21.6	18.2	16.4	38.0	19.0	4.6	14.2	13.8	22.2	28.3
36.3	37.0	45.3	38.0	39.2	60.0	60.0	300.0	120.0	135.0	0.0	0.0	0.0	0.0	0.0	31.0	10.0	14.0	9.0	4.0	68.0												
39.4	39.6	45.3	41.9	41.5	65.0	90.0	60.0	255.0	117.5	60.0	60.0	150.0	30.0	75.0	34.0	13.0	13.0	14.0	5.0	79.0												
38.3	36.5	38.7	39.0	38.1	45.0	30.0	110.0	105.0	72.5	20.0	0.0	0.0	30.0	12.5	25.0	9.0	13.0	11.0	5.0	63.0												
32.5	37.8	37.8	40.1	37.0	80.0	140.0	0.0	120.0	85.0	0.0	0.0	0.0	0.0	0.0	14.0	6.0	9.0	13.0	2.0	44.0												
34.2	32.0	35.5	34.7	34.1	30.0	10.0	70.0	25.0	33.8	0.0	0.0	0.0	0.0	0.0	25.0	6.0	9.0	13.0	2.0	55.0												
42.6	37.1	47.0	36.6	40.8	60.0	30.0	330.0	60.0	120.0	90.0	45.0	0.0	20.0	38.8	35.0	12.0	12.0	13.0	2.0	74.0	164.6	47.0	17.5	18.7	14.2	27.0	19.0	4.8	9.6	12.4	18.5	29.5
33.2	32.6	33.2	32.8	32.9	15.0	25.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	28.0	7.0	12.0	9.0	4.0	60.0												
39.5	36.4	42.5	42.8	40.3	210.0	60.0	270.0	60.0	150.0	0.0	0.0	0.0	90.0	22.5	30.0	8.0	15.0	10.0	2.0	65.0	146.0	29.0	13.6	16.4	15.5	19.0	18.0	6.8	7.6	6.2	11.3	35.7
39.6	31.3	38.4	32.7	35.5	100.0	0.0	120.0	0.0	55.0	30.0	0.0	0.0	0.0	7.5	29.0	12.0	10.0	11.0	2.0	64.0												
31.7	31.7	32.8	35.3	32.9	0.0	0.0	0.0	20.0	5.0	0.0	0.0	0.0	0.0	0.0	22.0	8.0	14.0	10.0	2.0	56.0	154.5	37.0	15.5	21.4	18.7	31.0	19.0	6.4	16.4	16.6	25.2	34.3
52.0	32.2	37.2	32.9	38.6	385.0	0.0	105.0	5.0	123.8	0.0	0.0	0.0	0.0	0.0	21.0	8.0	15.0	7.0	2.0	53.0												
32.8	30.6	33.6	33.2	32.5	50.0	10.0	10.0	25.0	23.8	0.0	0.0	20.0	0.0	5.0	27.0	13.0	12.0	8.0	2.0	62.0												
40.2	32.9	33.3	32.5	34.7	150.0	30.0	45.0	30.0	63.8	0.0	0.0	0.0	0.0	0.0	31.0	14.0	10.0	7.0	2.0	64.0												
41.4	34.9	37.9	38.8	38.2	100.0	55.0	105.0	160.0	105.0	50.0	0.0	0.0	0.0	12.5	30.0	9.0	12.0	9.0	2.0	62.0	157.0	43.0	17.4	19.3	17.9	36.0	16.0	6.4	14.4	10.4	20.4	31.0
31.0	34.9	32.8	32.0	32.7	0.0	60.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	11.0	4.0	13.0	9.0	2.0	39.0	160.5	40.0	15.6	14.7	14.0	18.5	16.0	4.6	10.6	9.4	17.3	28.3
33.7	31.8	32.1	32.8	32.6	55.0	30.0	0.0	10.0	23.8	0.0	0.0	0.0	0.0	0.0	27.0	13.0	15.0	10.0	6.0	71.0												
38.1	36.3	43.1	35.9	38.3	90.0	60.0	40.0	90.0	70.0	0.0	0.0	0.0	0.0	0.0	28.0	9.0	11.0	15.0	3.0	66.0	150.5	52.0	23.1	22.7	24.5	22.0	21.0	6.1	15.2	19.2	25.8	32.9
32.1	32.4	33.4	34.2	33.0	40.0	75.0	5.0	5.0	31.3	0.0	0.0	0.0	0.0	0.0	27.0	11.0	12.0	11.0	6.0	67.0												
37.4	34.8	40.3	36.5	37.2	35.0	85.0	95.0	0.0	53.8	0.0	0.0	0.0	0.0	0.0	9.0	4.0	4.0	4.0	5.0	26.0												
42.4	36.1	40.0	36.5	38.7	240.0	120.0	225.0	60.0	161.3	0.0	0.0	0.0	0.0	0.0	13.0	4.0	4.0	6.0	2.0	29.0												

33.3	34.2	43.4	41.7	38.1	0.0	40.0	20.0	60.0	30.0	120.0	120.0	0.0	0.0	60.0	31.0	11.0	11.0	12.0	4.0	69.0												
35.3	37.2	36.8	34.9	36.0	15.0	80.0	70.0	45.0	52.5	0.0	0.0	0.0	0.0	0.0	27.0	10.0	9.0	7.0	5.0	58.0												
37.9	35.9	36.7	37.2	36.9	30.0	10.0	70.0	135.0	61.3	60.0	50.0	30.0	0.0	35.0	27.0	6.0	7.0	10.0	2.0	52.0												
32.9	32.4	30.8	31.5	31.9	30.0	25.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	18.0	4.0	12.0	9.0	2.0	45.0												
34.0	35.3	38.7	29.5	34.4	60.0	60.0	95.0	0.0	53.8	0.0	0.0	0.0	0.0	0.0	24.0	11.0	12.0	10.0	4.0	61.0												
43.2	42.9	34.5	41.1	40.4	105.0	0.0	0.0	30.0	33.8	90.0	75.0	10.0	90.0	66.3	26.0	11.0	9.0	10.0	2.0	58.0												
50.0	35.5	34.4	34.4	38.6	360.0	90.0	45.0	45.0	135.0	0.0	0.0	0.0	0.0	0.0	18.0	4.0	13.0	11.0	7.0	53.0												
33.0	29.8	31.6	31.3	31.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	8.0	12.0	13.0	5.0	63.0	162.0	50.0	19.1	22.3	18.6	12.5	19.0	4.8	15.4	16.6	24.6	29.5
34.4	33.9	46.5	34.3	37.3	240.0	0.0	30.0	0.0	67.5	0.0	0.0	0.0	0.0	0.0	24.0	6.0	12.0	8.0	3.0	53.0	165.0	59.5	21.9	29.8	26.7	10.0	22.0	5.2	26.6	25.2	36.8	30.2
41.0	32.9	37.1	36.0	36.8	100.0	25.0	115.0	70.0	77.5	60.0	0.0	0.0	0.0	15.0	33.0	16.0	13.0	15.0	3.0	80.0												
32.4	34.1	51.3	43.1	40.2	10.0	0.0	25.0	60.0	23.8	0.0	30.0	240.0	120.0	97.5	32.0	7.0	14.0	10.0	3.0	66.0												
37.0	36.4	44.0	46.8	41.1	15.0	120.0	300.0	240.0	168.8	60.0	0.0	0.0	60.0	30.0	33.0	8.0	14.0	11.0	3.0	69.0												
34.8	37.3	46.6	44.2	40.7	30.0	75.0	190.0	110.0	101.3	0.0	0.0	20.0	0.0	5.0	28.0	5.0	10.0	10.0	5.0	58.0												
36.2	35.4	41.7	35.6	37.2	210.0	70.0	60.0	30.0	92.5	0.0	0.0	0.0	0.0	0.0	19.0	4.0	9.0	5.0	2.0	39.0												
33.7	37.1	34.8	37.3	35.7	30.0	110.0	40.0	70.0	62.5	0.0	0.0	0.0	0.0	0.0	35.0	10.0	10.0	9.0	2.0	66.0												
34.3	37.1	32.6	32.4	34.1	10.0	10.0	35.0	95.0	37.5	0.0	0.0	0.0	10.0	2.5	28.0	13.0	8.0	11.0	2.0	62.0	158.5	56.5	22.5	28.8	21.2	15.0	24.0	5.8	11.4	18.6	23.0	31.8
37.3	33.4	36.8	32.4	35.0	120.0	0.0	20.0	10.0	37.5	0.0	0.0	0.0	0.0	0.0	32.0	13.0	8.0	10.0	3.0	66.0												
31.1	32.7	30.5	30.3	31.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	5.0	10.0	11.0	6.0	45.0												
39.8	43.5	51.9	42.1	44.3	85.0	105.0	280.0	180.0	162.5	60.0	60.0	60.0	0.0	45.0	36.0	11.0	9.0	12.0	2.0	70.0												
38.8	36.3	53.6	39.0	41.9	155.0	95.0	90.0	160.0	125.0	0.0	0.0	240.0	0.0	60.0	32.0	11.0	11.0	11.0	3.0	68.0												
38.7	37.2	51.9	36.9	41.2	330.0	90.0	80.0	60.0	140.0	30.0	30.0	30.0	30.0	30.0	33.0	9.0	13.0	14.0	7.0	76.0	160.0	57.5	22.5	24.4	22.6	16.0	26.0	5.8	12.8	14.6	20.8	31.8
36.2	32.4	31.0	34.8	33.6	0.0	0.0	0.0	30.0	7.5	60.0	5.0	10.0	10.0	21.3	30.0	12.0	11.0	14.0	4.0	71.0												
33.4	34.4	33.6	35.7	34.3	15.0	55.0	15.0	80.0	41.3	0.0	0.0	0.0	0.0	0.0	24.0	5.0	12.0	14.0	2.0	57.0												
34.0	31.4	32.6	33.4	32.8	55.0	0.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	22.0	4.0	13.0	13.0	4.0	56.0												
39.0	40.4	36.0	39.9	38.8	0.0	20.0	120.0	115.0	63.8	90.0	75.0	0.0	5.0	42.5	25.0	8.0	11.0	13.0	5.0	62.0												
36.8	32.5	34.3	31.1	33.7	80.0	25.0	90.0	25.0	55.0	20.0	0.0	0.0	0.0	5.0	36.0	12.0	11.0	10.0	2.0	71.0												
34.5	35.5	35.8	33.6	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	4.0	10.0	16.0	8.0	47.0												
33.5	34.6	35.0	35.0	34.5	0.0	40.0	60.0	120.0	55.0	0.0	0.0	0.0	0.0	0.0	34.0	13.0	14.0	15.0	6.0	82.0												
32.7	39.2	42.8	34.4	37.3	0.0	170.0	215.0	60.0	111.3	0.0	0.0	0.0	0.0	0.0	30.0	11.0	11.0	10.0	2.0	64.0												
37.5	37.1	38.0	36.7	37.3	60.0	55.0	60.0	40.0	53.8	15.0	11.0	15.0	10.0	12.8	31.0	14.0	9.0	14.0	3.0	71.0												
32.8	36.2	36.7	37.1	35.7	35.0	115.0	105.0	45.0	75.0	0.0	0.0	15.0	60.0	18.8	34.0	12.0	12.0	13.0	5.0	76.0												
34.7	35.5	34.2	31.4	33.9	30.0	60.0	20.0	30.0	35.0	0.0	0.0	0.0	0.0	0.0	26.0	13.0	8.0	12.0	3.0	62.0												
32.6	34.5	32.3	33.6	33.3	0.0	10.0	10.0	30.0	12.5	0.0	0.0	0.0	0.0	0.0	28.0	13.0	11.0	5.0	2.0	59.0												
33.3	33.3	35.5	30.8	33.2	10.0	35.0	25.0	10.0	20.0	0.0	0.0	0.0	0.0	0.0	34.0	15.0	10.0	12.0	6.0	77.0												
32.3	32.0	31.3	29.5	31.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	13.0	12.0	10.0	6.0	72.0												
32.5	34.7	36.2	32.0	33.8	0.0	45.0	40.0	30.0	28.8	0.0	0.0	0.0	0.0	0.0	25.0	13.0	9.0	11.0	4.0	62.0												
32.3	32.4	31.0	32.6	32.1	10.0	5.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	22.0	10.0	13.0	10.0	2.0	57.0	164.5	62.0	22.9	22.2	19.6	26.0	16.0	4.4	28.4	25.2	28.0	27.6
32.6	34.3	32.4	39.3	34.7	30.0	480.0	5.0	30.0	136.3	0.0	0.0	0.0	0.0	0.0	19.0	8.0	12.0	10.0	2.0	51.0												
32.6	34.8	35.4	33.4	34.0	25.0	110.0	40.0	45.0	55.0	0.0	0.0	10.0	0.0	2.5	34.0	12.0	14.0	15.0	7.0	82.0	163.5	54.0	20.3	18.8	15.7	13.0	22.0	9.4	19.0	16.2	26.5	44.5
32.6	32.3	45.8	39.5	37.5	310.0	90.0	20.0	10.0	107.5	0.0	0.0	0.0	0.0	0.0	18.0	7.0	12.0	9.0	5.0	51.0	166.5	52.5	19.0	21.4	22.6	18.0	19.0	4.2	19.8	19.2	28.9	26.8
39.8	37.9	32.6	39.4	37.4	60.0	120.0	0.0	105.0	71.3	0.0	0.0	0.0	0.0	0.0	30.0	13.0	15.0	11.0	3.0	72.0	165.0	52.5	19.3	23.5	18.9	23.0	27.0	6.0	14.4	16.8	24.0	32.9
31.8	33.6	33.6	29.3	32.1	5.0	45.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0	0.0	36.0	11.0	12.0	16.0	6.0	81.0												
45.3	35.6	36.4	36.5	38.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	4.0	13.0	10.0	3.0	53.0												
36.0	37.1	38.8	35.1	36.8	40.0	45.0	45.0	15.0	36.3	0.0	0.0	15.0	0.0	3.8	36.0	10.0	15.0	16.0	8.0	85.0												

43.1	39.8	38.5	36.8	39.6	270.0	170.0	40.0	30.0	127.5	0.0	0.0	60.0	60.0	30.0	35.0	9.0	13.0	12.0	2.0	71.0												
37.2	37.6	36.8	35.7	36.8	10.0	85.0	105.0	40.0	60.0	20.0	10.0	0.0	0.0	7.5	29.0	9.0	10.0	14.0	5.0	67.0												
33.6	34.2	31.4	31.1	32.6	5.0	40.0	25.0	15.0	21.3	0.0	0.0	0.0	0.0	0.0	23.0	8.0	10.0	9.0	3.0	53.0												
35.5	40.5	32.8	32.1	35.2	110.0	220.0	10.0	0.0	85.0	0.0	0.0	0.0	0.0	0.0	31.0	11.0	11.0	10.0	2.0	65.0												
34.5	35.0	34.4	35.2	34.8	25.0	10.0	30.0	30.0	23.8	0.0	0.0	0.0	0.0	0.0	34.0	12.0	12.0	12.0	5.0	75.0												
35.3	33.6	32.5	31.2	33.1	90.0	45.0	10.0	15.0	40.0	0.0	0.0	0.0	0.0	0.0	36.0	11.0	12.0	14.0	8.0	81.0												
35.1	34.8	34.2	37.7	35.4	20.0	0.0	20.0	90.0	32.5	0.0	0.0	0.0	0.0	0.0	30.0	10.0	7.0	10.0	2.0	59.0												
30.8	31.6	35.5	36.4	33.6	40.0	40.0	20.0	80.0	45.0	0.0	0.0	0.0	0.0	0.0	23.0	6.0	10.0	9.0	4.0	52.0												
32.7	31.8	35.9	31.8	33.1	5.0	0.0	75.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	25.0	10.0	10.0	9.0	2.0	56.0												
34.6	31.0	39.5	32.3	34.3	10.0	0.0	70.0	50.0	32.5	10.0	0.0	60.0	0.0	17.5	15.0	6.0	5.0	7.0	3.0	36.0												
33.1	35.5	41.8	40.3	37.7	10.0	50.0	50.0	40.0	37.5	0.0	0.0	120.0	60.0	45.0	33.0	13.0	9.0	7.0	2.0	64.0	163.0	50.0	18.8	25.4	22.8	34.0	26.0	8.0	5.6	6.2	12.4	39.9
32.4	33.1	31.9	32.0	32.3	10.0	30.0	25.0	45.0	27.5	0.0	0.0	0.0	0.0	0.0	21.0	7.0	7.0	14.0	6.0	55.0												
28.1	32.9	33.2	32.9	31.8	30.0	0.0	60.0	40.0	32.5	0.0	10.0	10.0	10.0	7.5	31.0	9.0	11.0	16.0	5.0	72.0												
33.4	33.2	39.0	33.4	34.7	120.0	50.0	30.0	30.0	57.5	0.0	0.0	0.0	0.0	0.0	26.0	10.0	14.0	14.0	3.0	67.0												
36.3	37.0	38.3	33.0	36.2	0.0	75.0	15.0	45.0	33.8	60.0	0.0	20.0	0.0	20.0	25.0	12.0	10.0	8.0	4.0	59.0												
32.9	32.7	37.3	31.4	33.6	10.0	10.0	20.0	10.0	12.5	0.0	0.0	0.0	0.0	0.0	34.0	12.0	13.0	8.0	2.0	69.0												
34.8	34.9	41.0	49.3	40.0	30.0	45.0	180.0	150.0	101.3	0.0	0.0	0.0	60.0	15.0	34.0	12.0	10.0	13.0	5.0	74.0												
46.7	37.7	43.4	39.5	41.8	60.0	0.0	110.0	110.0	70.0	120.0	120.0	120.0	0.0	90.0	27.0	9.0	5.0	9.0	2.0	52.0												
33.3	31.5	46.0	37.0	36.9	45.0	0.0	315.0	0.0	90.0	0.0	0.0	0.0	0.0	0.0	25.0	8.0	7.0	8.0	3.0	51.0												
32.5	33.2	42.4	36.2	36.1	0.0	0.0	240.0	120.0	90.0	0.0	0.0	0.0	0.0	0.0	14.0	6.0	8.0	9.0	2.0	39.0	171.5	76.0	25.7	34.7	32.7	45.0	23.0	4.2	18.4	17.4	27.1	26.8
32.3	32.0	30.3	30.0	31.1	0.0	0.0	10.0	5.0	3.8	0.0	0.0	0.0	0.0	0.0	23.0	12.0	10.0	8.0	4.0	57.0												
33.5	33.6	31.5	31.0	32.4	30.0	0.0	20.0	20.0	17.5	0.0	0.0	0.0	0.0	0.0	34.0	11.0	12.0	16.0	8.0	81.0												
33.8	41.2	38.1	33.8	36.7	60.0	15.0	125.0	60.0	65.0	0.0	120.0	0.0	0.0	30.0	26.0	10.0	12.0	10.0	3.0	61.0												
40.6	34.7	41.3	37.0	38.4	160.0	105.0	60.0	75.0	100.0	0.0	0.0	60.0	0.0	15.0	28.0	11.0	11.0	11.0	3.0	64.0	164.5	50.0	18.6	26.5	19.5	31.0	14.0	5.6	11.0	15.6	21.6	31.8
31.8	33.3	31.0	32.8	32.2	0.0	10.0	0.0	20.0	7.5	0.0	0.0	0.0	10.0	2.5	22.0	7.0	13.0	8.0	2.0	52.0												
35.0	37.3	46.9	34.8	38.5	60.0	75.0	180.0	120.0	108.8	0.0	0.0	120.0	0.0	30.0	34.0	14.0	12.0	15.0	3.0	78.0												
35.8	37.3	32.2	39.1	36.1	0.0	15.0	0.0	90.0	26.3	60.0	35.0	0.0	0.0	23.8	32.0	14.0	13.0	12.0	4.0	75.0												
37.5	33.6	36.4	33.2	35.2	0.0	30.0	10.0	10.0	12.5	65.0	0.0	60.0	30.0	38.8	36.0	14.0	12.0	15.0	6.0	83.0												
32.1	31.8	36.7	36.0	34.1	30.0	110.0	0.0	0.0	35.0	45.0	0.0	0.0	0.0	11.3	14.0	10.0	13.0	7.0	3.0	47.0												
32.4	31.7	46.8	32.0	35.7	0.0	0.0	240.0	60.0	75.0	0.0	0.0	0.0	0.0	0.0	24.0	8.0	13.0	12.0	4.0	61.0												
42.0	55.5	51.7	49.4	49.6	35.0	30.0	70.0	15.0	37.5	60.0	160.0	120.0	90.0	107.5	32.0	16.0	14.0	12.0	5.0	79.0	149.8	44.0	19.6	19.8	20.5	24.0	23.0	7.0	8.8	7.8	13.5	36.4
32.8	34.1	33.5	32.5	33.2	40.0	55.0	25.0	40.0	40.0	0.0	0.0	0.0	0.0	0.0	34.0	13.0	11.0	15.0	6.0	79.0												
33.6	31.7	31.9	34.7	33.0	15.0	10.0	0.0	30.0	13.8	0.0	0.0	0.0	0.0	0.0	31.0	10.0	14.0	15.0	7.0	77.0												
37.6	35.4	51.5	38.8	40.8	85.0	80.0	180.0	120.0	116.3	30.0	0.0	120.0	30.0	45.0	34.0	7.0	13.0	12.0	6.0	72.0												
37.5	39.7	41.9	31.5	37.6	145.0	165.0	30.0	0.0	85.0	30.0	0.0	0.0	0.0	7.5	28.0	12.0	7.0	10.0	2.0	59.0												
31.8	31.0	33.5	38.5	33.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	4.0	11.0	11.0	5.0	40.0												
42.9	38.2	45.9	39.5	41.6	65.0	55.0	195.0	30.0	86.3	90.0	30.0	55.0	0.0	43.8	34.0	7.0	10.0	12.0	2.0	65.0												
38.6	36.1	38.3	37.0	37.5	150.0	115.0	100.0	210.0	143.8	0.0	0.0	60.0	0.0	15.0	31.0	12.0	12.0	12.0	2.0	69.0												
32.8	33.3	30.3	30.0	31.6	0.0	0.0	10.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	26.0	11.0	7.0	10.0	5.0	59.0												
44.0	31.8	40.4	43.0	39.8	60.0	90.0	85.0	180.0	103.8	0.0	0.0	0.0	0.0	0.0	33.0	9.0	9.0	8.0	2.0	61.0												
34.5	34.6	38.0	46.9	38.5	0.0	0.0	70.0	60.0	32.5	60.0	0.0	0.0	0.0	15.0	35.0	11.0	13.0	9.0	2.0	70.0	149.5	60.5	27.0	30.6	28.2	22.0	24.0	4.6	22.0	21.8	33.3	28.3
31.9	33.7	32.3	32.7	32.7	20.0	55.0	10.0	20.0	26.3	0.0	0.0	0.0	0.0	0.0	36.0	15.0	13.0	13.0	3.0	80.0												
38.9	37.3	34.0	29.6	34.9	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	12.5	19.0	7.0	12.0	9.0	3.0	50.0												

36.6	32.8	40.9	35.8	36.5	0.0	10.0	120.0	30.0	40.0	60.0	0.0	45.0	50.0	38.8	33.0	12.0	11.0	11.0	3.0	70.0												
33.3	33.3	36.5	38.8	35.4	150.0	0.0	30.0	30.0	52.5	0.0	120.0	0.0	0.0	30.0	20.0	10.0	9.0	9.0	3.0	51.0	169.5	49.5	17.2	30.2	26.5	16.0	24.0	6.5	18.8	20.6	29.7	34.3
35.5	35.5	42.5	38.8	38.1	60.0	60.0	120.0	60.0	75.0	0.0	0.0	60.0	60.0	30.0	30.0	8.0	13.0	14.0	2.0	67.0												
34.6	40.0	43.8	37.8	39.0	150.0	60.0	30.0	20.0	65.0	60.0	60.0	0.0	90.0	52.5	29.0	8.0	14.0	11.0	3.0	65.0	166.5	57.0	20.6	34.5	28.2	26.0	24.0	5.8	18.2	16.8	26.7	31.8
33.9	35.8	33.2	33.4	34.1	80.0	95.0	10.0	0.0	46.3	0.0	0.0	0.0	0.0	0.0	27.0	8.0	15.0	15.0	3.0	68.0												
38.6	33.7	33.3	38.5	36.0	185.0	30.0	30.0	90.0	83.8	0.0	10.0	0.0	0.0	2.5	24.0	12.0	10.0	12.0	3.0	61.0												
32.2	32.1	35.9	32.3	33.1	0.0	0.0	0.0	40.0	10.0	0.0	0.0	0.0	0.0	0.0	29.0	9.0	10.0	11.0	2.0	61.0												
35.1	39.0	32.9	32.6	34.9	0.0	15.0	25.0	20.0	15.0	10.0	63.0	0.0	15.0	22.0	38.0	12.0	11.0	15.0	3.0	77.0												

Appendix XIV
Results of Repeated Measures ANOVA conducted on energy expenditure data.

Table 4. Results from within subject effects for 'days' of the week according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	p
Days	3650.966	3	1473.662	32.953	*<0.01*
Days x school year	266.866	6	53.858	2.301	*<0.05*
Days x ethnicity	176.030	6	35.526	1.518	*>0.05*
Days x sex	136.237	3	54.990	2.349	*>0.05*
Days x ethnicity x sex	201.53	6	40.675	1.738	*>0.05*
Error	15020.620	777	19.332		

Table 5. Results from within subject effects for 'time' according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	p
Time	152.275	1	152.275	5.602	*<0.05*
Time x school year	8.287	2	40142	.152	*>0.05*
Time x ethnicity	394.186	2	197.093	7.251	*<0.01*
Time x sex	3.226	1	3.226	.119	*>0.05*
Time x ethnicity x sex	232.322	2	116.161	4.273	*<0.05*
Error	7040.362	259	27.183		

Table 6. Results from within subject effects for 'time' by 'days' of the week interactions according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	p
Time x days	631.386	3	253.072	12.233	*<0.01*
Time x days x school year	230.087	6	46.112	2.229	*<0.05*
Time x days x ethnicity	190.318	6	38.142	1.844	*>0.05*
Time x days x sex	4.263	3	1.709	.083	*>0.05*
Time x days x ethnicity x sex	26.841	6	5.379	.260	*>0.05*
Error	13367.798	777	20.688		

Table 7. Results from tests of between subject effects.

	Type III sum of squares	df	Mean square	F	p
School year	260.880	2	130.440	1.893	*>0.05*
Ethnicity	1391.024	2	695.512	10.094	*<0.01*
Sex	756.851	1	756.851	10.984	*<0.01*
Ethnicity x sex	350.010	2	175.005	2.540	*>0.05*
Error	17846.265	259	68.904		

Appendix XV

Means and standard deviations for average daily energy expenditure

Table 8. Means and standard deviations (M±S.D.) for average daily energy expenditure (kcal kg^{-1} day^{-1}) across days of the week between phases one and two according to school year, ethnicity and sex.

			Weekday 1		Weekday 2		Saturday		Sunday		Average	
School Year	Ethnicity	Sex	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two
Overall sample			35.5±3.8	36.1±4.3	35.9±4.5	35.6±4.0	41.1±8.2	38.0±5.0	37.7±6.7	35.8±4.4	37.5±4.3	36.4±3.2
Year A			35.2±3.3	36.5±4.0	35.4±3.8	36.3±4.0	42.7±9.3	38.9±5.0	39.0±7.2	36.0±4.4	38.1±4.4	36.9±3.1
Year B			36.2±4.6	36.2±4.2	37.2±5.5	35.9±4.3	41.2±8.6	37.5±5.3	37.8±7.7	36.4±5.2	38.1±5.0	36.5±3.5
Year C			35.3±3.3	35.4±4.9	35.1±3.7	34.4±3.2	39.4±6.3	37.5±4.5	36.2±4.8	34.9±3.4	36.5±3.4	35.5±2.7
	White		36.3±4.3	37.0±4.9	36.8±5.0	36.0±4.2	43.1±8.9	39.1±5.0	39.4±7.8	36.2±4.2	38.9±4.7	37.1±3.1
	Black		34.9±3.0	37.1±4.6	36.1±5.2	36.8±5.2	41.6±8.6	39.0±4.9	37.1±5.5	36.1±5.7	37.5±3.9	37.3±3.7
	Asian		34.6±2.8	34.4±2.7	34.4±2.7	34.6±3.0	37.8±5.7	35.0±4.5	35.2±4.2	35.0±4.2	35.5±2.9	35.1±2.7
		Boys	36.6±4.2	36.9±3.4	37.5±5.3	36.5±3.6	44.2±9.3	40.1±5.2	40.2±7.8	37.1±5.0	39.6±4.7	37.6±3.0
		Girls	35.0±3.4	35.5±4.8	35.0±3.7	35.1±4.1	39.5±7.1	36.8±4.4	36.4±5.8	34.9±3.9	36.5±3.7	35.6±3.0
Year A	White		35.9±3.7	36.5±3.6	36.1±4.4	36.1±3.1	44.7±9.4	40.0±5.3	41.4±7.8	36.3±4.3	39.5±4.4	37.2±2.7
	Black		34.3±2.3	39.1±5.4	35.6±4.4	39.5±6.1	43.7±8.1	39.1±4.7	37.1±4.7	36.4±5.7	37.7±3.1	38.5±4.4
	Asian		34.5±3.2	35.2±3.3	34.6±2.4	35.1±3.5	38.3±7.6	37.0±4.4	36.0±4.2	35.2±4.0	35.9±3.1	35.6±2.6
		Boys	36.1±3.6	37.3±3.4	36.9±4.6	37.4±4.3	45.8±9.8	40.9±5.3	41.6±8.2	37.0±4.9	40.1±4.3	38.1±3.1
		Girls	34.4±3.1	35.8±4.3	34.4±2.6	35.4±3.6	39.9±7.4	37.1±4.2	36.9±4.6	35.0±3.8	36.4±3.1	35.8±2.7
	White	Boys	37.1±3.7	37.3±3.4	37.3±4.8	36.9±3.3	48.1±9.9	41.0±5.3	43.8±8.7	37.1±4.2	41.6±4.1	39.1±2.7
		Girls	34.3±3.1	35.3±3.5	34.3±3.0	34.9±2.4	40.0±6.1	38.5±5.0	37.9±4.8	35.1±4.2	36.6±2.8	36.0±2.3
	Black	Boys	34.8±2.6	37.7±3.8	36.7±5.6	40.5±7.3	42.3±8.6	40.3±5.8	36.6±5.8	35.2±6.4	37.6±3.6	38.4±5.1
		Girls	33.7±1.8	40.7±6.7	34.5±2.1	38.4±4.8	45.3±7.8	37.7±2.7	37.7±3.4	37.7±4.9	37.8±2.7	38.6±3.9
	Asian	Boys	33.4±1.5	36.5±3.0	35.4±2.7	35.9±2.1	39.1±6.8	41.4±5.3	37.1±3.4	38.5±5.9	36.3±1.5	38.1±2.4
		Girls	34.8±3.5	34.8±3.3	34.4±2.2	34.9±3.8	38.1±8.0	35.5±2.9	35.6±4.4	34.1±2.6	35.7±3.5	34.8±2.2

School Year	Ethnicity	Sex	Weekday 1		Weekday 2		Saturday		Sunday		Average	
			Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up
Year B	White		36.4±4.5	37.2±5.0	38.2±5.8	36.3±5.3	42.5±10.8	38.1±5.4	38.8±10.4	37.0±4.7	39.0±5.9	37.2±3.8
	Black		35.1±4.0	36.6±3.8	38.7±7.8	35.2±3.3	38.5±7.1	37.4±5.3	36.0±6.7	36.0±7.2	37.1±5.3	36.3±3.4
	Asian		35.0±2.8	34.7±2.5	34.5±2.7	35.6±3.2	39.6±6.3	36.9±5.2	36.3±5.1	35.7±5.2	36.4±3.4	35.7±3.2
		Boys	36.3±3.9	37.0±3.6	37.8±6.0	35.7±3.0	43.2±8.3	39.0±5.4	39.0±7.8	37.2±5.7	39.1±4.6	37.2±3.3
		Girls	35.3±3.9	35.6±4.5	36.2±5.0	36.0±5.1	39.3±9.1	36.5±5.0	36.5±8.6	35.8±4.8	36.8±5.3	36.0±3.7
	White	Boys	36.7±4.6	36.8±3.8	39.3±6.8	35.7±2.2	43.9±8.4	38.7±5.5	39.8±8.4	37.4±5.8	39.9±4.9	37.1±3.4
		Girls	36.2±4.5	37.6±6.0	37.2±4.6	37.0±7.1	41.1±12.7	37.6±5.4	37.9±12.1	36.5±3.4	38.1±6.8	37.2±4.2
	Black	Boys	34.3±1.3	38.7±4.9	36.3±3.5	34.2±0.8	37.4±6.6	36.9±4.3	33.4±3.9	34.3±4.6	35.3±2.7	36.0±3.0
		Girls	35.6±5.2	35.2±2.2	40.4±10.0	35.9±4.2	39.3±8.0	37.6±6.2	37.7±7.8	37.2±8.7	38.3±6.4	36.5±3.9
	Asian	Boys	36.5±2.7	36.9±2.7	35.4±3.9	36.4±4.4	43.8±8.5	40.3±5.7	39.3±7.1	37.9±5.9	38.8±4.3	37.8±3.3
		Girls	34.3±2.6	33.7±1.6	34.1±1.8	35.2±2.4	37.6±3.7	35.3±4.2	34.8±3.1	34.7±4.6	35.2±2.2	34.7±2.7
Year C	White		36.8±4.2	37.5±6.4	35.7±3.9	35.6±4.2	42.8±6.8	39.1±3.9	37.7±5.1	35.4±3.4	38.2±3.8	36.9±2.7
	Black		34.9±3.2	34.2±1.6	34.7±1.9	33.7±1.3	39.9±7.2	40.7±4.9	38.3±7.1	35.8±3.9	36.9±3.7	36.1±1.9
	Asian		34.1±2.1	33.6±2.3	33.8±2.2	33.4±1.8	36.2±4.5	35.1±3.8	33.8±3.1	34.1±3.2	34.5±2.3	34.1±2.0
		Boys	35.9±4.1	36.0±3.1	36.5±4.0	35.7±2.2	41.2±7.4	40.3±4.2	36.7±5.3	37.3±4.0	37.6±4.5	37.3±2.3
		Girls	35.2±3.4	35.2±5.3	34.2±2.7	34.0±3.4	39.0±6.3	36.6±4.2	35.7±4.8	34.1±2.8	36.0±3.3	35.0±2.6
	White	Boys	36.2±4.3	36.5±3.2	36.8±4.5	36.1±2.3	42.4±7.6	40.0±4.9	37.2±5.1	36.7±3.6	38.2±4.8	37.3±2.5
		Girls	37.1±4.3	38.0±7.5	35.1±3.6	35.4±4.9	43.0±6.5	38.7±3.4	37.9±5.1	34.7±3.1	38.3±3.3	36.7±2.8
	Black	Boys	35.8±4.2	35.7±0.2	35.0±2.9	34.5±1.1	42.4±4.7	42.5±4.8	40.4±10.3	38.8±7.4	38.4±4.1	37.9±2.7
		Girls	34.5±3.3	33.7±1.6	34.6±1.8	33.4±1.3	39.0±8.1	40.1±5.2	37.5±6.9	34.8±2.4	36.4±3.9	35.5±1.4
	Asian	Boys	35.1±4.3	35.0±3.8	36.3±3.3	35.0±2.3	37.7±8.1	39.9±2.6	33.9±3.5	38.2±4.3	35.8±4.2	37.0±2.1
		Girls	33.9±1.6	33.4±1.9	33.4±1.8	33.1±1.7	36.0±3.9	34.4±3.4	33.7±3.1	33.5±2.6	34.3±1.9	33.6±1.6

Appendix XVI
Results of analyses conducted on time spent in moderate activity data.

Table 9. Results of Kruskal Wallis tests for unrelated samples, mean ranks, means and standard deviations (M±S.D.) for time spent in moderate activity according to school year, ethnicity and sex

	Phase one			Phase two		
	χ^2	Mean rank	M±S.D.	χ^2	Mean rank	M±S.D.
School Year	11.06*			4.35		
Year A		222.7	82.1±53.1		142.5	63.4±42.1
Year B		192.9	69.0±49.2		139.2	65.0±49.1
Year C		177.2	64.4±45.9		118.1	53.7±46.3
Ethnicity	18.34*			.980		
White		218.9	81.1±54.1		155.0	73.5±49.1
Black		196.5	70.1±48.6		135.5	58.4±38.0
Asian		165.8	56.6±39.7		105.3	45.1±38.5
Sex	20.15*			.118		
Boys		233.4	86.9±53.7		154.5	73.0±48.2
Girls		179.0	63.0±46.0		121.4	53.6±42.8

*p<0.01

Table 9b. Results of Wilcoxen test for related samples, mean rank, means and standard deviations for differences between time spent in moderate activity between phases one and two.

	Phase one		Phase two	
Z	Mean rank	M±S.D.	Mean rank	M±S.D.
-3.19*	138.19	71.1±50.0	122.11	61.0±45.9

*p<0.01

Appendix XVII
Results of analyses conducted on time spent in vigorous activity data.

Table 10. Results of Kruskal Wallis tests for unrelated samples, mean ranks, means and standard deviations (M±S.D.) for time spent in vigorous activity according to school year, ethnicity and sex

	Phase one			Phase two		
	χ^2	Mean rank	M±S.D.	χ^2	Mean rank	M±S.D.
School Year	22.48*			.17		
Year A		217.4	19.8±24.8		162.0	18.6±22.7
Year B		215.3	23.0±34.4		139.1	13.6±20.1
Year C		161.7	10.1±18.7		94.3	4.8±12.1
Ethnicity	56.22*			.76		
White		233.9	25.4±32.3		138.6	13.4±19.8
Black		205.3	16.1±19.6		147.6	18.6±26.0
Asian		140.8	5.9±12.2		123.3	10.0±17.4
Sex	61.87*			29.99*		
Boys		254.9	30.2±28.8		174.1	22.8±24.0
Girls		168.0	10.9±23.6		109.2	6.5±13.7

*p<0.01

Table 10b. Results of Wilcoxen test for related samples, mean rank, means and standard deviations for differences between time spent in vigorous activity between phases one and two.

	Phase one		Phase two	
Z	Mean rank	M±S.D.	Mean rank	M±S.D.
-2.68*	89.32	17.5±27.0	98.05	12.7±19.9

*p<0.01

Appendix XVIII.

Physical activity status categorisation

Table 11. Percentages (and numbers) classified in each activity status according to average daily energy expenditure (kcal kg^{-1} day^{-1}) for phases one and two of the study and according to school year, ethnicity and sex.

Sample	Study	Very inactive	Inactive	Moderately active	Active
All participants	Phase two	12.7 (34)	50.6 (135)	24.0 (64)	12.7 (34)
	Phase one	10.1 (40)	44.2 (174)	21.6 (85)	24.1 (95)
Year 8	Phase two	7.1 (7)	52.5 (52)	24.2 (24)	16.2 (16)
	Phase one	9.8 (13)	36.1 (48)	24.8 (33)	29.3 (39)
Year 9	Phase two	16.1 (14)	46.0 (40)	21.8 (19)	16.1 (14)
	Phase one	9.6 (12)	42.4 (53)	18.4 (23)	29.6 (37)
Year 10	Phase two	16.1 (13)	53.1 (43)	25.9 (21)	4.9 (4)
	Phase one	11.0 (15)	53.7 (73)	21.3 (29)	14.0 (19)
Boys	Phase two	4.9 (5)	41.2 (42)	33.3 (34)	20.6 (21)
	Phase one	4.5 (6)	32.1 (43)	22.4 (30)	41.0 (55)
Girls	Phase two	17.6 (29)	56.4 (93)	18.2 (30)	7.8 (13)
	Phase one	13.1 (34)	50.4 (131)	21.1 (55)	15.4 (40)
White	Phase two	7.5 (10)	42.5 (57)	34.3 (46)	15.7 (21)
	Phase one	5.7 (12)	34.1 (72)	26.1 (55)	34.1 (72)
Black	Phase two	6.1 (2)	57.6 (19)	21.2 (7)	15.1 (5)
	Phase one	9.5 (4)	42.9 (18)	19.0 (8)	28.6 (12)
Asian	Phase two	22.0 (22)	59.0 (59)	11.0 (11)	8.0 (8)
	Phase one	17.0 (24)	59.6 (84)	15.6 (22)	7.8 (11)

Appendix XIX.
Percentages (and numbers) meeting current physical activity guidelines

Table 12. Percentages (and numbers) meeting current physical activity guidelines for phases one and two according to school year, ethnicity and sex.

Sample	Study	NIH/HEA (60min)	HEA (30 min)	Not meeting guidelines
All participants	Phase two	50.2 (134)	27.0 (72)	22.8 (61)
	Phase one	58.4 (230)	25.4 (100)	16.2 (64)
Year A	Phase two	61.6 (61)	24.3 (24)	14.1 (14)
	Phase one	66.9 (89)	20.3 (27)	12.8 (17)
Year B	Phase two	50.6 (44)	25.3 (22)	24.1 (21)
	Phase one	59.2 (74)	28.8 (36)	12.0 (15)
Year C	Phase two	35.8 (29)	32.1 (26)	32.1 (26)
	Phase one	49.3 (67)	27.2 (37)	23.5 (32)
Boys	Phase two	67.6 (69)	21.6 (22)	10.8 (11)
	Phase one	85.8 (115)	7.5 (10)	6.7 (9)
Girls	Phase two	39.4 (65)	30.3 (50)	30.3 (50)
	Phase one	48.0 (125)	30.8 (80)	21.2 (55)
White	Phase two	61.2 (82)	23.9 (32)	14.9 (20)
	Phase one	70.5 (148)	20.5 (43)	9.0 (19)
Black	Phase two	54.6 (18)	24.2 (8)	21.2 (7)
	Phase one	55.8 (24)	25.6 (11)	18.6 (8)
Asian	Phase two	34.0 (34)	32.0 (32)	34.0 (34)
	Phase one	41.1 (58)	32.6 (46)	26.3 (37)

Appendix XX
Results of MANOVA conducted on attitude towards physical education data

Table 13. Results of multivariate effects according to school year, ethnicity and sex for phase one of the study

	Value	F	Hypothesis df	Error df	*p*
School year	.937	2.447	10	744	*<0.01*
Ethnicity	.942	2.37	10	744	*<0.01*
Sex	.974	2.011	5	372	*>0.05*
School year x ethnicity	.927	1.420	20	1234.734	*>0.05*
School year x sex	.979	.790	10	744	*>0.05*
Ethnicity x sex	.952	1.865	10	744	*<0.05*
School year x ethnicity x sex	.906	1.859	20	1234.734	*<0.05*

Table 14. Results of multivariate effects according to school year, ethnicity and sex for phase two of the study

	Value	F	Hypothesis df	Error df	*p*
School year	.905	2.557	10	498	*<0.01*
Ethnicity	.952	1.246	10	498	*>0.05*
Sex	.970	1.555	5	249	*>0.05*
School year x ethnicity	.920	1.055	20	826.789	*>0.05*
School year x sex	.942	1.497	10	498	*>0.05*
Ethnicity x sex	.899	2.734	10	498	*<0.01*

Table 15. Results of univariate effects according to school year, ethnicity and sex for phase one of the study

	DV	Type III sum of squares	df	Mean square	F	*p*
School year	D1	453.659	2	226.830	8.312	*<0.01*
	D2	37.891	2	18.945	2.516	*>0.05*
	D3	13.103	2	6.552	1.331	*>0.05*
	D4	49.560	2	24.780	3.080	*<0.05*
	D5	11.461	2	5.730	2.218	*>0.05*
Ethnicity	D1	83.458	2	41.729	1.529	*>0.05*
	D2	12.504	2	6.252	.830	*>0.05*
	D3	44.627	2	22.313	4.535	*<0.05*
	D4	24.366	2	12.183	1.515	*>0.05*
	D5	3.940	2	1.970	.763	*>0.05*
Sex	D1	99.168	1	99.168	3.634	*>0.05*
	D2	1.520	1	1.520	.002	*>0.05*
	D3	3.095	1	3.095	.006	*>0.05*
	D4	2.980	1	2.980	.370	*>0.05*
	D5	13.672	1	13.672	5.293	*<0.05*
School year x ethnicity	D1	330.842	4	82.710	3.031	*<0.05*
	D2	67.828	4	16.957	2.252	*>0.05*
	D3	4.221	4	1.055	.214	*>0.05*
	D4	16.840	4	4.210	.523	*>0.05*
	D5	13.798	4	3.449	1.335	*>0.05*
School year x sex	D1	6.750	2	3.375	.124	*>0.05*
	D2	4.707	2	2.353	.313	*>0.05*
	D3	9.450	2	4.725	.960	*>0.05*
	D4	18.747	2	9.374	1.165	*>0.05*
	D5	5.959	2	2.979	1.153	*>0.05*
Ethnicity x sex	D1	86.528	2	43.264	1.585	*>0.05*
	D2	24.658	2	12.329	1.638	*>0.05*
	D3	37.043	2	18.521	3.764	*<0.05*
	D4	13.471	2	6.735	.837	*>0.05*
	D5	5.204	2	2.602	1.007	*>0.05*
School year x ethnicity x sex	D1	287.382	4	71.845	2.633	*<0.05*
	D2	78.852	4	19.713	2.618	*<0.05*
	D3	3.603	4	.901	.183	*>0.05*
	D4	30.703	4	7.676	.954	*>0.05*
	D5	26.749	4	6.687	2.589	*<0.05*
Error	D1	10261.13	376	27.290		
	D2	2830.928	376	7.529		
	D3	1850.117	376	4.921		
	D4	3024.669	376	8.044		
	D5	971.307	376	2.583		

Table 16. Results of univariate effects according to school year, ethnicity and sex for phase two of the study

	DV	Type III sum of squares	df	Mean square	F	*p*
School year	D1	669.075	2	334.538	9.559	*<0.01*
	D2	93.151	2	46.576	5.705	*<0.01*
	D3	35.394	2	17.697	3.212	*<0.05*
	D4	16.315	2	8.158	1.027	*>0.05*
	D5	6.873	2	3.437	1.226	*>0.05*
Ethnicity	D1	176.544	2	88.272	2.522	*>0.05*
	D2	67.238	2	33.618	4.118	*<0.05*
	D3	5.757	2	2.878	.522	*>0.05*
	D4	3.821	2	1.911	.241	*>0.05*
	D5	10.254	2	5.127	1.829	*>0.05*
Sex	D1	73.353	1	73.353	2.096	*>0.05*
	D2	.466	1	.466	.057	*>0.05*
	D3	15.688	1	15.688	2.847	*>0.05*
	D4	1.737	1	1.737	.219	*>0.05*
	D5	.298	1	.298	.106	*>0.05*
School year x ethnicity	D1	372.427	4	93.107	2.660	*<0.05*
	D2	41.821	4	10.455	1.281	*>0.05*
	D3	9.736	4	2.434	.442	*>0.05*
	D4	42.504	4	10.626	1.338	*>0.05*
	D5	13.665	4	3.416	1.219	*>0.05*
School year x sex	D1	231.444	2	115.722	3.307	*<0.05*
	D2	14.569	2	7.284	.892	*>0.05*
	D3	27.923	2	13.961	2.534	*>0.05*
	D4	38.806	2	19.403	2.444	*>0.05*
	D5	7.201	2	3.600	.013	*>0.05*
Ethnicity x sex	D1	100.108	2	50.054	1.430	*>0.05*
	D2	6.977	2	3.489	.427	*>0.05*
	D3	62.294	2	31.147	5.653	*<0.01*
	D4	21.022	2	10.511	1.324	*>0.05*
	D5	13.463	2	6.731	2.402	*>0.05*
Error	D1	8854.508	253	34.998		
	D2	2065.332	253	8.163		
	D3	1394.081	253	5.510		
	D4	2008.659	253	7.939		
	D5	709.018	253	2.802		

Appendix XXI
Means and standard deviations for attitude towards physical education

Table 17. Means and standard deviations (M±S.D.) for attitude towards PE between phases one and two according to school year, ethnicity and sex.

School Year	Ethnicity	Sex	General Interest		Assessment		PE Teacher		Environmental Adjustment		Organisational Choice		Total Attitude	
			Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two	Phase one	Phase two
Overall sample			28.1±5.7	27.3±6.6	10.5±2.8	9.6±3.0	11.5±2.3	11.2±2.4	10.8±2.9	10.9±2.8	3.4±1.6	3.6±1.7	64.3±6.6	62.7±11.7
Year A			29.8±4.8	29.6±4.4	11.0±2.6	10.3±2.6	11.7±2.2	11.5±2.4	11.1±3.0	11.1±2.7	3.5±1.8	3.5±1.6	67.0±9.0	65.9±8.6
Year B			29.2±4.8	27.6±6.3	10.8±2.8	9.9±2.8	11.7±2.4	11.6±2.2	11.0±2.9	11.1±2.6	3.2±1.6	3.8±1.7	70.0±9.4	64.0±11.4
Year C			25.5±6.2	24.2±7.8	9.6±3.0	8.5±3.3	11.2±2.3	10.6±2.6	10.5±2.7	10.5±3.2	3.3±1.5	3.6±1.8	60.1±10.3	57.3±13.4
	White		27.8±5.9	26.8±7.2	10.2±2.8	9.2±3.0	12.0±2.3	11.3±2.5	10.7±2.9	10.8±3.0	3.2±1.5	3.3±1.6	63.9±10.5	61.4±12.5
	Black		28.4±5.4	28.7±4.5	10.8±2.5	10.6±2.9	11.3±2.3	11.7±2.5	10.2±2.9	11.2±2.4	3.4±1.8	3.9±1.7	64.0±10.4	66.0±10.4
	Asian		28.4±5.4	27.6±6.2	10.8±2.9	9.9±2.8	10.8±2.1	10.9±2.3	11.2±2.8	11.0±2.8	3.6±1.8	3.9±1.7	64.9±9.3	63.3±10.8
		Boys	29.2±5.2	29.2±6.3	10.6±2.7	9.8±3.1	11.5±2.2	11.5±2.6	10.7±2.8	11.1±2.9	3.0±1.3	3.5±1.7	65.1±9.1	65.3±12.0
		Girls	27.5±5.8	26.1±6.5	10.4±2.9	9.5±2.9	11.5±2.3	11.0±2.3	10.9±2.9	10.8±2.8	3.5±1.8	3.6±1.7	63.8±10.5	61.1±11.2
Year A	White		29.8±5.0	30.4±4.5	11.1±2.5	10.3±2.7	12.1±1.9	11.5±2.2	10.8±3.0	11.4±2.7	3.3±1.6	3.4±1.7	67.0±9.3	67.0±8.6
	Black		27.1±4.8	29.7±3.9	10.4±1.8	10.9±3.0	11.7±2.3	11.5±2.5	10.8±3.2	11.1±2.4	4.0±2.0	3.9±1.6	63.9±10.7	67.2±9.5
	Asian		31.2±3.8	28.1±3.9	11.3±2.9	10.1±2.3	10.7±2.5	11.1±2.6	11.7±2.8	10.6±2.7	3.6±2.1	3.3±1.5	68.5±7.1	63.2±7.7
		Boys	30.7±3.7	32.0±3.3	11.0±2.2	10.4±2.8	12.0±1.7	12.0±2.3	11.3±2.4	11.8±2.5	3.2±1.4	3.5±1.7	38.2±5.7	69.6±6.9
		Girls	29.1±5.5	27.5±4.2	11.1±2.8	10.3±2.4	11.4±2.5	10.9±2.3	10.8±3.4	10.5±2.7	3.7±2.1	3.4±1.6	66.1±10.9	62.6±8.7
	White	Boys	31.8±2.8	32.8±2.9	11.2±2.5	10.5±2.7	12.1±1.6	11.5±2.3	11.4±2.5	12.1±2.7	3.0±1.3	3.3±1.7	69.5±5.2	70.3±7.3
		Girls	27.5±6.0	27.1±4.3	10.9±2.6	10.0±2.6	12.2±2.2	11.5±2.0	10.1±3.5	10.5±2.6	3.5±1.8	3.5±1.7	64.3±12.0	32.5±8.4
	Black	Boys	27.4±4.3	29.5±4.0	10.8±1.7	10.9±3.4	12.0±2.3	12.4±2.3	10.8±2.6	11.5±2.3	4.0±1.5	4.6±1.6	65.0±6.7	68.9±8.0
		Girls	26.5±5.7	29.9±4.1	9.8±2.1	11.0±2.7	11.3±2.4	10.6±2.6	10.8±4.1	10.7±2.7	3.9±2.6	3.1±1.3	62.1±15.4	65.3±11.3
	Asian	Boys	30.1±3.8	30.6±2.7	9.9±1.2	9.1±2.4	11.7±1.8	13.6±1.3	12.0±1.8	10.9±1.3	2.9±0.9	3.0±1.4	66.6±4.1	67.1±2.4
		Girls	31.4±3.8	27.3±4.0	11.7±3.1	10.4±2.2	10.5±2.6	10.4±2.5	11.6±2.9	10.5±3.0	3.8±2.2	3.4±1.6	69.0±7.6	62.0±8.4

School Year	Ethnicity	Sex	General Interest		Assessment		PE Teacher		Environmental Adjustment		Organisational Choice		Total Attitude	
			Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up
Year B	White		28.7±5.3	25.5±6.4	10.3±2.6	9.0±2.9	12.2±2.4	11.6±2.0	11.0±2.8	10.5±2.5	3.1±1.5	3.3±1.5	65.3±10.0	59.8±10.8
	Black		30.8±4.4	28.6±5.2	11.5±2.5	10.8±2.4	10.9±2.5	12.6±2.5	9.9±2.4	11.1±2.2	2.8±1.0	4.2±1.5	65.9±7.5	67.3±11.4
	Asian		29.6±4.1	30.1±5.7	11.5±3.0	10.8±2.6	11.1±2.0	11.3±2.2	11.3±3.1	11.9±2.8	3.6±2.0	4.3±1.8	67.1±8.8	68.4±10.6
		Boys	29.8±4.6	29.0±5.0	10.6±2.6	10.1±2.8	11.4±2.5	11.6±2.5	10.8±3.0	10.9±2.7	2.7±1.3	3.6±1.6	65.3±9.1	65.3±10.5
		Girls	28.8±4.9	26.7±7.0	11.0±2.9	9.7±2.9	11.9±2.2	11.5±1.9	11.1±2.9	11.3±2.6	3.6±1.8	3.9±1.8	66.4±9.6	63.1±12.1
	White	Boys	28.7±4.6	27.4±5.1	10.0±2.3	9.2±2.7	11.4±2.6	11.1±2.5	11.1±3.0	10.7±2.7	3.1±1.4	3.5±1.8	64.6±9.6	62.0±10.2
		Girls	28.7±5.8	23.6±7.0	10.7±2.8	8.7±3.0	12.8±2.1	12.0±1.3	10.8±2.7	10.3±2.3	3.1±1.5	3.1±1.2	66.2±10.4	57.7±11.1
	Black	Boys	33.0±3.8	29.3±4.3	10.8±3.3	10.8±1.3	11.5±2.9	13.0±0.8	9.3±2.6	10.8±1.7	2.3±0.5	4.5±1.3	66.8±7.1	68.3±5.4
		Girls	29.8±4.4	28.2±6.1	11.9±2.2	10.8±3.1	10.7±2.5	12.3±3.2	10.2±2.4	11.3±2.7	3.0±1.1	4.0±1.8	65.6±8.0	66.7±14.7
	Asian	Boys	31.5±4.3	31.8±4.3	12.2±2.4	11.5±2.8	11.4±2.5	12.1±2.8	10.4±3.1	11.5±3.1	2.0±0.0	3.5±1.4	67.4±8.5	70.5±10.7
		Girls	28.7±3.8	29.2±6.2	11.2±3.2	10.4±2.5	11.0±1.8	10.9±1.9	11.8±3.1	12.2±2.7	4.3±2.0	4.7±1.9	66.9±9.1	67.3±10.6
Year C	White		24.8±6.2	22.7±8.9	9.1±3.1	7.7±3.2	11.6±2.6	10.8±3.2	10.3±2.8	10.3±3.8	3.2±1.3	3.3±1.7	59.0±10.7	54.8±15.6
	Black		27.8±7.2	27.0±4.6	10.8±3.7	9.6±3.3	10.9±2.1	10.8±2.5	5.2±2.7	11.4±2.8	3.0±1.9	3.4±2.1	61.7±13.6	62.1±11.0
	Asian		25.9±6.1	24.9±7.2	10.0±2.7	9.0±3.2	10.7±1.8	10.4±2.0	10.9±2.5	10.5±2.7	3.6±1.6	3.9±1.7	61.0±9.5	58.7±11.3
		Boys	25.0±6.7	23.2±9.2	10.0±3.5	7.8±3.8	10.7±2.4	10.3±3.2	9.2±2.7	9.7±3.7	3.1±1.3	3.5±1.7	58.1±11.2	54.5±17.4
		Girls	25.6±6.1	24.5±7.4	9.5±2.9	8.7±3.1	11.3±2.2	10.7±2.4	10.8±2.6	10.7±3.0	3.4±1.5	3.6±1.8	60.5±10.1	58.2±12.0
	White	Boys	24.3±7.2	22.8±10.4	10.2±3.7	7.7±3.9	10.7±2.6	10.0±3.8	9.1±3.0	10.1±4.4	2.9±1.2	3.5±2.0	57.2±12.1	54.1±20.1
		Girls	25.0±5.9	22.9±8.2	8.7±2.8	7.7±2.9	11.9±2.5	11.1±2.9	10.8±2.6	10.3±3.6	3.3±1.3	3.2±1.6	59.6±10.2	55.2±12.9
	Black	Boys	32.0±2.0	29.0±0.0	12.0±1.7	9.0±7.1	10.7±2.3	11.5±2.1	10.3±2.1	10.0±1.4	2.7±0.6	3.0±1.4	67.7±8.1	62.5±12.0
		Girls	25.7±8.1	26.3±5.3	10.2±4.4	9.8±2.3	11.0±2.2	10.5±2.8	8.7±3.0	11.8±3.1	3.2±2.4	3.5±2.3	58.7±15.4	62.0±11.9
	Asian	Boys	23.7±4.8	21.6±7.9	8.3±3.3	7.8±3.3	10.8±2.1	10.6±2.3	9.2±2.5	8.8±2.5	4.0±1.5	3.6±1.5	56.0±8.2	52.4±11.6
		Girls	26.1±6.2	25.4±7.0	10.2±2.6	9.2±3.2	10.7±1.8	10.4±2.0	11.0±2.5	10.7±2.6	3.5±1.6	4.0±1.8	61.6±9.5	59.7±11.1

Appendix XXII
Results of repeated measures ANOVA conducted on health related fitness data

Table 19. Results from within subject effects for 'time' for percent body fat according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	55.706	1	55.706	4.417	*<0.05*
Time x school year	29.070	2	14.535	1.153	*>0.05*
Time x ethnicity	9.643	2	4.821	.382	*>0.05*
Time x sex	7.584	1	7.584	.601	*>0.05*
Time x school year x ethnicity	44.236	4	11.059	.877	*>0.05*
Error	668.360	53	12.611		

Table 20. Results from tests of between subject effects for percent body fat according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
School year	490.047	2	245.024	2.621	*>0.05*
Ethnicity	198.038	2	99.019	1.059	*>0.05*
Sex	1536.321	1	1536.321	16.435	*<0.01*
School year x ethnicity	966.000	4	241.500	2.583	*<0.05*
Error	4954.410	53	93.476		

Table 21. Results from within subject effects for BMI for 'time' according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	10.671	1	10.671	2.838	*>0.05*
Time x school year	4.962	2	2.481	.660	*>0.05*
Time x ethnicity	2.959	2	1.479	.393	*>0.05*
Time x sex	19.024	1	19.024	5.059	*<0.05*
Time x school year x ethnicity	24.833	4	6.208	1.651	*>0.05*
Error	199.315	53	3.761		

Table 22. Results from tests of between subject effects for BMI according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*P*
School year	92.379	2	46.190	1.953	*>0.05*
Ethnicity	81.594	2	40.797	1.725	*>0.05*
Sex	91.347	1	91.347	3.862	*>0.05*
School year x ethnicity	289.075	4	72.269	3.055	*<0.05*
Error	1253.685	53	23.654		

Table 23. Results from within subject effects for 'time' for cardiovascular fitness according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	6.752	1	6.752	1.395	*>0.05*
Time x school year	1.101	2	.550	.114	*>0.05*
Time x ethnicity	4.963	2	2.482	.513	*>0.05*
Time x sex	12.911	1	12.911	2.667	*>0.05*
Time x school year x ethnicity	7.439	4	1.860	.384	*>0.05*
Error	256.591	53	4.841		

Table 24. Results from tests of between subject effects for cardiovascular fitness according to school year, ethnicity and sex

	Type III sum of squares	Df	Mean square	F	*p*
School year	60.219	2	30.110	.637	*>0.05*
Ethnicity	108.292	2	54.146	1.145	*>0.05*
Sex	493.953	1	493.953	10.449	*<0.01*
School year x ethnicity	505.082	4	126.271	2.671	*<0.05*
Error	2505.373	53	47.271		

Table 25. Results from within subject effects for 'time' for flexibility according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	14.312	1	14.312	1.841	*>0.05*
Time x school year	33.548	2	16.774	2.158	*>0.05*
Time x ethnicity	7.175	2	3.587	.462	*>0.05*
Time x sex	1.586	1	1.586	.002	*>0.05*
Error	435.243	56	7.772		

Table 26. Results from tests of between subject effects for flexibility according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
School year	215.823	2	107.912	1.448	*>0.05*
Ethnicity	564.235	2	282.117	3.785	*<0.05*
Sex	289.730	1	289.730	3.887	*>0.05*
Error	4174.391	56	74.543		

Table 27. Results from within subject effects for 'time' for muscular endurance according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	156.251	1	156.251	25.727	*<0.01*
Time x school year	3.254	2	1.627	.268	*>0.05*
Time x ethnicity	2.408	2	1.204	.198	*>0.05*
Time x sex	3.671	1	3.671	.604	*>0.05*
Error	340.113	56	6.073		

Table 28. Results from tests of between subject effects for muscular endurance according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
School year	170.286	2	85.143	5.584	*<0.01*
Ethnicity	119.082	2	59.541	3.905	*<0.05*
Sex	774.859	1	774.859	50.818	*<0.01*
Error	853.875	56	15.248		

Table 29. Results from within subject effects for 'time' for muscular strength of the dominant hand according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	192.290	1	192.290	34.574	*<0.01*
Time x school year	11.367	2	5.683	1.022	*>0.05*
Time x ethnicity	6.686	2	3.343	.601	*>0.05*
Time x sex	4.142	1	4.142	.745	*>0.05*
Error	305.892	55	5.562		

Table 30. Results from tests of between subject effects for muscular strength of the dominant hand according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
School year	931.549	2	465.775	11.279	*<0.01*
Ethnicity	253.163	2	126.581	3.065	*>0.05*
Sex	242.824	1	242.824	5.880	*<0.05*
Error	2271.202	55	41.295		

Table 31. Results from within subject effects for 'time' for muscular strength of the non-dominant hand according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
Time	160.107	1	160.107	25.103	*<0.01*
Time x school year	31.809	2	15.905	2.494	*>0.05*
Time x ethnicity	7.508	2	3.754	.589	*>0.05*
Time x sex	9.927	1	9.927	1.556	*>0.05*
Error	350.792	55	6.378		

Table 32. Results from tests of between subject effects for muscular strength of the non-dominant hand according to school year, ethnicity and sex

	Type III sum of squares	df	Mean square	F	*p*
School year	750.818	2	375.409	9.747	*<0.01*
Ethnicity	350.687	2	175.344	4.553	*<0.05*
Sex	163.508	1	163.508	4.245	*<0.05*
Error	2118.292	55	38.514		

Appendix XXIII.
Relationship between physical activity and attitude towards physical education

Table 33. Pearson's product moment correlation coefficients (r) between young people's physical activity and attitude towards physical education for phase one.

	Average daily energy expenditure (kcal kg^{-1} day^{-1})	Moderate activity (min.)	Vigorous activity (min.)
General interest	.179**	.133**	.197**
Assessment	.097	.118*	.085
PE teacher	.122*	.058	.155**
Environmental adjustment	.022	-.002	.043
Organisational choice	-.020	.015	-.007
Total attitude	.159**	.122*	.182**

** $p<0.01$
* $p<0.05$

Table 34. Pearson's product moment correlation coefficients (r) between young people's physical activity and attitude towards physical education for phase two.

	Average daily energy expenditure (kcal kg^{-1} day^{-1})	Moderate activity (min.)	Vigorous activity (min.)
General interest	.233**	.151*	.279**
Assessment	.039	-.066	.144*
PE teacher	.068	.103	.025
Environmental adjustment	.025	-.047	.148*
Organisational choice	-.147*	-.122	-.063
Total attitude	.140*	.060	.226**

** $p<0.01$
* $p<0.05$

Appendix XXIV
Relationship between physical activity and health related fitness

Table 35. Pearson's product moment correlation coefficients (r) between young people's physical activity and health related fitness variables for phase one.

Fitness variable	Average daily energy expenditure (kcal kg^{-1} day^{-1})	Moderate activity (min.)	Vigorous activity (min.)
Height	-.021	-.012	-.027
Weight	-.048	-.014	-.091
BMI	.002	-.010	-.025
Percent body fat	.030	.022	.048
Cardiovascular endurance	.208*	.112	.196*
Flexibility	.057	.093	-.067
Muscular endurance	.275**	.169*	.204*
Grip strength (dominant hand)	.109	.097	-.051
Grip strength (non-dominant hand)	.072	.080	-.081

** $p<0.01$
* $p<0.05$

Table 36. Pearson's product moment correlation coefficients (r) between young people's physical activity and health related fitness variables from phase two of the study.

Fitness variable	Average daily energy expenditure (kcal kg^{-1} day^{-1})	Moderate activity (min.)	Vigorous activity (min.)
Height	-.230	.055	-.278**
Weight	-.091	-.059	-.164
BMI	.078	-.085	.016
Percent body fat	-.174	.096	-.236*
Cardiovascular endurance	.208	.112	.237
Flexibility	.083	-.024	.148
Muscular endurance	.324**	.215	.325**
Grip strength (dominant hand)	.009	.006	.048
Grip strength (non-dominant hand)	.080	.016	.066

** $p<0.01$
* $p<0.05$